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OCEANOGRAPHY OF THE NORTH ATLANTIC.*

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The study of the ocean, to which the title of Oceanography is given, occupies a considerable field in science, which, in spite of the interest it offers from many points of view, has been little cultivated until quite recent times. This omission need not provoke surprise, for mankind has only quite lately taken an interest in scientific knowledge, and had long remained the slave of prejudice and childish legend. What soil so favourable for the weaving of legend as the sea, till now immeasurable and unfathomable, inhabited by beings scarcely perceived, more alive than the forests on land, when tempests heap its waters wave upon wave, when it vibrates under the shocks of nature?

A ray of truth was needed before the gates of free inquiry could be opened, and men could face without shrinking all the uncertainty which guides their fates. It was necessary that human nature should be moulded by the spirit of science before it could overcome the tendency to see its own type in all the problems of the universe.

It came as a revelation, when, in 1818, John Ross found an *Asteria* in Baffin's bay at a depth of 984 fathoms; and again, in 1860, when the soundings taken for the first Transatlantic cable between Ireland and Newfoundland brought up *Asteria* and *Serpulæ* from depths of 670 and 1240 fathoms; or, in 1863, when the Americans used a trawl successfully on their coasts down to a depth of 1400 fathoms; or, in 1865, when Alphonse Milne-Edwards recognized the presence of polypes on a piece of Trans-Mediterranean cable taken up from a depth of 1100 fathoms; and, finally, when from 1867 onwards special expeditions like those of

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Wyville-Thomson and Carpenter on the *Lightning* made collections in the deep seas to the north of Great Britain and off the west coast of Europe.

These efforts of intelligent pioneers marked the first triumph of free investigation over preconceived ideas, and science formally took possession of a region wider than the continents, wherein are mountains and valleys, warm and cold streams, light and oxygen, and everywhere abundant life.

Next came the *Challenger*, which made a wonderful voyage round the world under the command of Nares and Thomson, with a picked scientific staff of such men as Murray, Moseley, Buchanan, and the others. The *Challenger* brought home many unknown and unfamiliar creatures from every sea, and wealth of observations concerning their strange conditions of life.

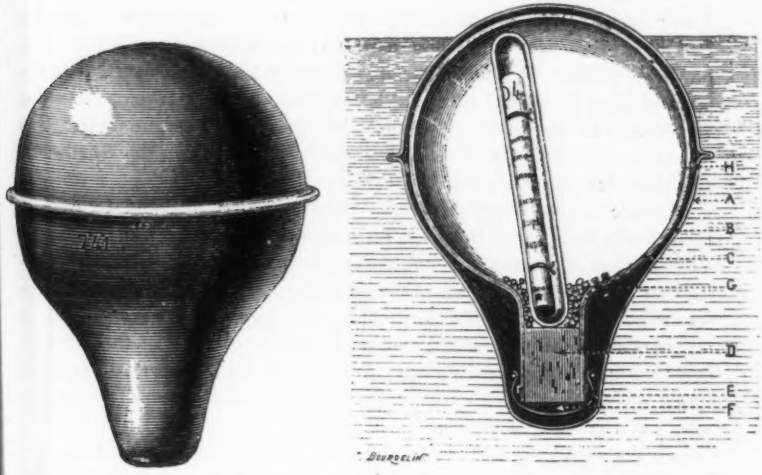
The example of all this devotion to scientific research gave me (a pupil of Spanish sailors) the ambition to contribute my share—and I would make it as large a share as possible—to the advancement of oceanography, of a science well fitted to seduce the imagination by the bond which it forms between poetry, philosophy, and pure science. For fifteen years I have given to it all the time and all the resources I have been able to spare from the duties of my life, and I shall continue to give them while strength remains. Coming after these expeditions, which had interrogated the sea somewhat feverishly, as one does in order to obtain the avowal of an important secret, I have thought it time to analyze in its details the problem already solved in its broader aspects. I chose the *massif* of the Azores as the first centre of closer investigation; this centre seemed the most suitable for my purpose, as it lies almost in mid-Atlantic, far from the influences of the mainland, and the great depths of the surrounding seas guarantee its purely oceanic character.

I set about my work in the summer of 1885, with no other apparatus than the *Hirondelle*, a little sailing schooner of 200 tons. From 1885 to 1889 I made some long cruises in the *Hirondelle*, which took me as far as the American coasts, and I explored depths as great as 1600 fathoms without help of any power greater than the arms of my fourteen sailors. My apprenticeship as an oceanographer being thus served, I secured the aid of such skilled colleagues as Dr. Richard, and later on, the *Hirondelle* being worn out by storms, I built a stronger steam-vessel, the *Princess Alice*, 560 tons, to carry on the same research with better appliances. The work of this second period has opened up to me fields of labour altogether beyond my reach without the aid of a still larger and more powerful vessel, so I have commissioned Messrs. Laird of Birkenhead to build me another *Princess Alice*, of 1400 tons, which will doubtless set out on her first voyage in a few weeks.

Currents.—Before studying the creatures exiled in the depths of the sea, it was necessary to complete the study of those conditions of

their life dependent on the statics and dynamics of the medium in which they live. To that end I wished, first of all, to establish the laws governing the surface currents of the North Atlantic, which play an important part in the distribution of heat and cold, of moisture and salinity, over the sea, and in the range and evolution of animal species.

Partly alone, partly in collaboration with Prof. Pouchet, I undertook an experiment on a large scale by means of floats. During the three years 1885, 1886, 1887 I launched on the surface of the North Atlantic three series of floats, so constructed and weighted as to follow



CURRENT FLOATS OR BOTTLES. A, SHELL OF COPPER; B, PITCH; C, GLASS BOTTLE; D, CORK STOPPER; E, LINEN CAP; F, SHIP'S GLUE; G, BALLAST; H, CORK BOTTLE FOR STRENGTHENING.

the movement of the surface water without being directly influenced by the wind.

These floats were, in 1885, copper spheres, wooden barrels, and ordinary bottles, to the number of 169 in all. In each of these was placed a notice, in several languages, enclosed in a sealed glass tube, asking the finders, whatever their nationality, to return this notice with a record of the place and date of finding. The floats were weighted—the spheres with a bag of sand, the barrels with an iron pig attached by an iron wire, and the bottles with the sealed tube containing the notice. The weights of the first two were supposed to become detached by the rotting of the bag or the rusting of the wire, so as roughly to compensate for the increase of weight caused by calcareous and organic accretions on the body of the float, and through which the latter could have sunk. In

1886, well-corked glass bottles were employed to the number of 510; and in the following year 931 strong glass floats with copper coverings were cast adrift.

The first series was launched over a distance of 170 miles to the north-west of the Western Azores; the second series over a distance of 500 miles along the 20th meridian west of Paris, and between the latitudes of the north of Spain and the south of England. The third series extended over 710 miles, of which 600 miles were right across the Gulf Stream between the Western Azores and the banks of Newfoundland.

Without going into details as to this long undertaking—carried out, I may repeat, with a little sailing schooner of 200 tons—I will give the results it produced up to 1892, in which year I drew up a definite map of the currents.* Up to that time, 226 out of the 1675 floats put in the sea had been found and returned to me from almost all the countries on the shores of the North Atlantic, both east and west, including the Canaries, Madeira, the Azores, the Antilles, Bermuda, the Shetlands, the Hebrides, the Orkneys, and Iceland.

I made minute inquiry into the probable course followed by each of these floats, comparing the dates on which they were launched with the dates of their discovery, and tabulating the dates of the successive findings on all the coasts; I was thus enabled to establish the fact that the influences of the Gulf Stream combine with those of certain prevailing winds, of evaporation over large areas, of the equilibrium of the different densities, and of the meeting of cold currents from the north, to produce a vast whirlpool rotating from left to right, which sweeps almost the whole of the North Atlantic.

This vortex begins towards the Antilles and Central America with the Gulf Stream, which issues from the Gulf of Mexico, and with the equatorial current; passing the banks of Newfoundland at a tangent, it turns to the east, approaches the European coasts, and runs southward from the Channel to Gibraltar; it then returns to the west, encircling the Canaries. A wide branch runs along the western coast of Ireland and of Norway, as far, at least, as Cape North. The centre oscillates somewhere to the south-west of the Azores.

My observations gave valuable indications of the speed of the different sections of this vortex. A comparison of the times taken by batches of floats of the same point of origin to reach their various stopping-places enabled me to establish the following average rates for the twenty-four hours:—

Between the Azores, France, Portugal, and the Canaries ...	5·18 miles.
From the Canaries to the Antilles, the Bahamas, and as far as the Bermudas	10·11 „
From the Bermudas to the Azores	6·42 „

* See *Proc. R.G.S.*, vol. xiv., p. 620.

The mean speed for the North Atlantic is 4·48 miles; but all these values are under rather than over the truth, since in most cases the floats were probably not found till some time after their arrival.

Depth and Pressure.—After the movements of the surface water of the ocean (that of the lower layers rapidly diminishing to, no doubt, nearly *nil* in the depths), the depth of the sea and the resultant pressure must be ascertained. The work of oceanographers during the last thirty years has taught us all we know of these matters, and it has dispelled the illusions which had filled the imagination of seamen and particularly of Magellan, the great navigator of the sixteenth century, who, having made in the Pacific the first sounding beyond 200 fathoms, declared it the deepest spot in the ocean.

To-day Otto Krümmel has been able to estimate the mean depths of all the seas, excepting only the polar region, as follows:—

Atlantic ocean	... ...	2012 fathoms.
Indian ocean	... ...	1828 „
Pacific ocean	... ...	2125 „
Antarctic ocean	... ...	1804 „
Arctic ocean	... ...	844 „
Mediterranean sea	... ...	732 „

The work done since Krümmel's calculations has not seriously modified these values. The greatest depth was found in the Pacific, 4688 fathoms, off the east coast of Japan.* Soundings in the North Atlantic have not yet exceeded 3878 fathoms, to the north of St. Thomas; but the latest explorations for projected cables may have slightly raised this figure.

To obtain accurate measurements of depths, a number of arrangements have been devised, from the simple lead plummet on a thick hemp line—which by its fantastic working allowed the imagination of the experimenters to discover depths of 6000 to 8000 fathoms—to the accurate apparatus which by the use of steel wire now gives measurements of the greatest depths to an approximation almost within the coefficient of elasticity of the metal. Since 1893 the progress which has been made in the construction of steel cables has led me to give up the use of single wires of this material, which are too liable to sudden breakage, in favour of a thin cable of nine wires, giving much greater strength, pliability, and safety, with but slightly increased diameter. I use for my soundings a machine that I invented in 1891, and which gives the best results. Its brake is automatic, and works through springs; the winding of the cable, the regulation of the speed when going up or down, its drying and greasing are all easily managed by one man.

Corresponding to these depths are pressures of which the atmospheric

* A greater depth has been lately reported from the Pacific.

pressure at the surface gives but a feeble idea. Thus, whereas under normal barometric conditions we live under a pressure equivalent to 15 lbs. per square inch, which is diminished in an insignificant ratio at altitudes of even hundreds of feet, marine creatures are subjected to a pressure of about 15 lbs. for every 5¼ fathoms of depth; and the tissues of deep-sea animals must have a special structure to enable their organs to be functional under such conditions.

TEMPERATURE.—At different depths the temperature of the water changes more or less regularly according to laws which have not yet been fully ascertained. The following are the values which I have observed in the neighbourhood of the Azores and at some points in the very deep water off Portugal (the numbers are uncorrected):—

547 fathoms	... ...	50·0° Fahr.
656 „	... ...	44·2° „
820 „	... ...	42·4° „
1093 „	... ...	39·0° „
1312 „	... ...	38·5° „
2406 „	... ...	36·9° „
2898 „	... ...	38·7° „
3007 „	... ...	38·5° „

These numbers present differences in different regions. According to the calculations of Murray, based on the observations of the *Challenger*, the mean temperature of the North Atlantic is higher by 1·2° Fahr. than that of other oceans, and it is to the deeper waters that this excess is chiefly due.

In order to ascertain these temperatures, special instruments had to be devised, capable of registering the temperature of a certain spot and of bringing the record to the surface without modification by its passage through waters of intermediate temperatures. The Miller-Casella thermometer was the first to fulfil the necessary conditions, but as it was a maximum and minimum instrument it did not afford an accurate determination of the temperature at the precise depth to be examined. Later, Negretti and Zambra produced a better instrument for the purpose. I employ a slight modification of the Negretti and Zambra pattern, called the Chabaud thermometer, which acts as follows: The reservoir is cylindrical, and holds mercury; at a certain point it is constricted, forming an angle and ending in a small bulb; the tube is then continued. This thermometer is enclosed in a glass tube, strong enough to withstand high pressures, while its outer reservoir dips into a layer of mercury, itself contained in the reservoir of the outer tube: it is in this way protected from breakage and to some extent from the effects of pressure.

To ascertain the temperature of any medium, it is only necessary to invert the instrument. The column of mercury, which stands at a certain height in the thermometer, breaks off at a constricted point of the reservoir, and falls to the lower part of the tube, where it can

undergo no further alteration. It only remains to read off the scale, which is inverted. The angle in the lower part was introduced by M. Chabaud to remove a defect in the Negretti and Zambra thermometers, which were liable to break the column inaccurately at the moment of inversion, a portion of the mercury from the reservoir sometimes following the column, and the subsequent impact against the bottom of the tube breaking the glass.

I invert the thermometer at the desired point by sending a "messenger" from the ship down the cable, which releases the armature by means of a lever; the thermometer, thus freed, swings over of itself. The messenger ought to reach the thermometer about ten minutes after it has been lowered to the point at which the observation is to be made, this being the time necessary for the mercury to acquire the temperature of its surroundings.

Density.—The composition of sea-water is of considerable interest in connection with the study of life in the sea, for it governs the respiratory functions of marine animals. It varies in different parts much more than that of the air; the degrees of salinity of the different seas of the Earth present such variations that the distribution of the various animal species is largely dependent upon them.

All the simple bodies should be found in the sea, for it is constantly receiving the washings of the land; but the salt which gives it its special character is sodium chloride. The proportion of this salt varies according as the seas are open or closed, according to the distance from coasts where rivers pour their fresh waters into it, according to the varying amounts of evaporation in the different regions, according to the distance from the melting icebergs of the polar regions, and according to the depth.

I consider Buchanan's bottle the best instrument for collecting samples of water, with the dissolved gases, at different depths, especially since conclusive experiments made during my voyage of 1896 showed that in the depth of the sea the amount of dissolved gas is independent of the pressure, and that even if that amount is slightly greater than at the surface, this is entirely due to the greater solubility of gases at the lower temperatures.

Dr. Jules Richard, the chief of my laboratory on board, has invented a thoroughly trustworthy instrument for demonstrating this fact, which we investigated in the year mentioned at depths of 547 and 1476 fathoms. In the experiment, the neck of an inverted bottle filled with mercury dips into a dish, also full of mercury; in this position the bottle is sent to the required depth; the dish is then lowered, so that the mercury can run out of the bottle and the sea-water run in; then the bottle is lowered so that its neck again dips into the mercury. If gas is set free as the apparatus is drawn up, and accumulates over the mercury, it was obviously dissolved in greater quantity under the

higher pressure; if, on the contrary, the bottle comes up full of water (as happened on the *Princess Alice*), the pressure does not increase the amount of gas in solution.

Sea-water contains four gases—oxygen, nitrogen, carbonic acid, and argon. The proportions in which these gases are present vary greatly with circumstances. The oxygen decreases and the carbonic acid increases with increasing depth—two facts first established by Carpenter, and known to have important relations to the abundance or scarcity of life in the various regions. After the researches made on my voyage of 1895, Dr. Richard was the first to announce the presence of argon in the swim-bladder of certain deep-sea fishes. We should expect that the deep layers of water would sooner or later become unfit to support respiration, especially in the absence of any restorative action by plants, which are rarely found below the 50-fathom line. Fortunately for the deep-sea fauna, however, the carbonic acid ascends by diffusion right up to the surface, while oxygen by the same means makes its way to the bottom. "It is," said Regnard, "a true respiratory process in the sea, assisted by the currents of the oceanic circulation." Thoulet showed that this diffusion of gases was brought about for inland seas where the current circulation is almost *nil*, as in the Mediterranean, by the fall of wind-borne dust on the sea, each grain of which, as it sinks, drags down with it adherent bubbles of air.

During the scientific expeditions of the Danish cruiser *Ingolf* in 1895 and 1896, M. Knudsen showed by analyses of samples of sea-water made immediately after collection, that the predominance of animal or vegetable life in any part causes the variations in the amount of contained oxygen or carbonic acid. Two bottles were filled with sea-water and corked, after the introduction into one of them of a large number of minute living crustaceans. Analysis of the gases three hours later showed that half the oxygen had been absorbed, while a slightly smaller amount of carbonic acid had been set free. Into the other bottle diatoms instead of crustaceans were introduced, and at the end of three hours, a quarter of the carbonic acid had been absorbed, while the quantity of oxygen was tripled.

Light.—It is of great importance to the marine biologist that he should know to what point light exists in the depths of the sea. Unfortunately, the only instrument which can tell us is our own retina, and its powers are purely relative; it cannot be doubted that some marine animals have far more penetrating sight than others. Some there are, too, which can receive luminous perceptions by means other than eyes properly so called. Thus, *Actinia*, *Medusæ*, *Velella*, *Spongiaria*, etc., when subjected to light of greater or less intensity, give evidence of sensations to which the name of "dermatoscopic" is given. The imperfection of the images which it presents to its possessors must make this vision a strange one, but it doubtless corresponds to the intelligence

it has to serve. Imagine the embarrassment of a holothurian or a medusa if suddenly provided with eyes as perfect and as seductive as those of some of my fair hearers!

Chemical experiments, such as the exposure of sensitive plates, have, indeed, been made to ascertain the depth to which the sun's light penetrates, but these are open to the objection that we do not know the precise limits of sensitiveness of the chemical substances employed. Further, it is possible that certain rays may penetrate sea-water which do not affect sensitized plates, just as red rays, which affect our retina, do not produce any impression on them. Be this as it may, Hermann Fol showed that the sun's rays ceased to act on the photographic plates he employed at a depth of 220 fathoms. I have here a graphic representation of the results of experiments I made to the south of Madeira with a photometrograph invented by my friend Dr. Regnard, which shows how rapidly light loses its intensity in penetrating below the surface.

On the other hand, it seems certain that, even if the light only penetrates to a comparatively short distance, many animals are able to store it up by means of special organs which serve them as lanterns, and to transport it, as it were, throughout the sea. Sometimes the number of minute animals emitting a phosphorescent glow is so great as to light up the water in which they live. In short, the question of light and vision in the depth of the sea is as yet but little understood; we can only assert that animals with well-developed eyes exist at all depths, and modern science teaches that an organ always atrophies or disappears when the conditions are such as to prevent its use.

Before showing you the animal life in the depths I must say something about the floor of the ocean itself, of the shifting materials on which is reared a column of water, sometimes as much as 4½ miles in height. You must think of the sea-bottom as of a great burying-place, where the bodies of countless creatures lie piled in the silence of their last long sleep. Do not protest against this excursion into the dominion of the mud which may at first seem barren and offensive. Here lie, sunk by the casualties of the sea, after their race is run in the light of the sun, great ships bearing wonders of our civilization and crowds of fortune-hunters, or of pleasure-seekers, collected from every corner of the earth. But this sea-mud, itself built out of death, will repel neither your senses nor your mind; it is not the horrible spectacle of decomposition we see around us, but one which rather recalls the old Christian motto, "Memento homo quia pulvis es, et quia in pulverem reverteris." As a matter of fact, organic decomposition does not appear, under the enormous pressures of the great depths, to present the same phenomenon as it does under atmospheric conditions.

The experiments in which Regnard, by means of special apparatus, artificially reproduced the phenomena of high pressures, showed

that substances most liable to putrefaction, such as eggs and meat, resist decomposition for an indefinite time when subjected to pressures of hundreds of atmospheres, corresponding to depths of thousands of fathoms. It would be too much to conclude from this that the microscopic agents of putrefaction do not exist in the deep seas; but, in the absence of further knowledge, it must be admitted, firstly, that any microbes dragged down by sinking bodies from the surface are paralyzed or killed by the pressure; and secondly, that such bodies escape putrefaction for a long time, and form food for the inhabitants of those regions, who must eagerly avail themselves of such opportunities, since, in the absence of plant-life, they are all carnivorous.

It has not proved much easier to ascertain the composition of the sea-bottom than it did to take the temperature or to collect samples of water, and many devices have been tried for bringing up samples of the ooze and mud at the bottom. I do not know of any with all the advantages of the Buchanan sounder, which accompanies the water-bottle known by his name. It consists of a cylindrical punch, which brings up a long column of mud without interfering with the stratification; only pure sand and bare rock escape it, and, as these are scarcely found beyond quite insignificant depths, they are easily obtained with simpler instruments.

The following is a short *résumé* of the results obtained from examination of deep-sea deposits by such savants as Murray, Thoulet, Buchanan, Regnard, and Ehrenberg.

Though little is known as yet of the precise laws governing the formation of these deposits, the question is one of vast interest to geologists, for many of our land formations, rocky and otherwise, have had the same origin. The bottom of the sea is the universal storehouse of all the mineral detritus brought down from the land by the action of running water, winds, and volcanoes; it accordingly becomes the scene of slow chemical and physical processes, going on on a gigantic scale. The material of which it is composed varies according to the geological formation of the neighbouring land, according to the principal currents of the upper levels, according to the direction of the prevailing winds, and, above all, according to the depth. The deposits divide the sea-floor into several distinct zones, which merge insensibly one into another, and on the whole fall into two main categories—the terrigenous and the pelagic deposits. In the first the essential materials are derived from the disintegration of the land; they reach out into sea as far as the currents can take them before great depths are attained. The second class corresponds to the parts of the sea farthest from land, and the deposits consist almost exclusively of disintegrated mineral substances existing in the skeletons of pelagic animals, which are found in such numbers that some of them have given their names to characteristic

deposits, such as the globigerina, pteropod, radiolarian, or diatom oozes.

The terrigenous deposits fall naturally into several zones:—

(1) The littoral zone, extending between the extreme tidal limits, in which rocks and other materials may be seen undergoing erosion under the direct action of the waves.

(2) The zone of Laminaria, in which the most luxuriant marine vegetation grows down to a depth of about 20 fathoms; the rock fragments are already much diminished in size, and form shingle, gravel, and sand.

(3) The coralline zone, extending to a depth of 50 fathoms, still fairly rich in plants, and perhaps the richest of all in animals. Already the depth of sand and mud is considerably greater.

(4) The deep zone, in which, at a depth of about 100 fathoms, those chemical actions begin which form muds of various kinds, arranged in layers or strata. There are, firstly, green muds, in which decomposition of organic matters occurs, and which still contain fragments of rock ranging from 0·20 inch to 0·79 inch in diameter. These extend to a depth of about 720 fathoms, and are succeeded by, secondly, the globigerina oozes, which go down to nearly 1950 fathoms. As the depth increases the proportion of lime becomes gradually less, and that of clay greater.

The globigerina are minute surface organisms, distributed over every sea; they form part of the group of Foraminifera, which includes three thousand known species of the simplest protozoan types in the animal kingdom. They possess a shell, which is transparent and provided with long spicules when the animal is alive, but resembles a lentil-seed riddled with holes after the inhabitant is dead. Down to a depth of 1950 fathoms the submarine deposits largely consist of shells of globigerina and similar calcareous *débris*; in greater depths it is supposed that chemical processes, in which the enormous pressure of the deep water plays a part, dissolve the calcareous substances before they reach the bottom.

The pelagic deposits consist of a series of muds in the abysmal depths, beginning with a red clay. The red clay often contains fine mineral grains—rarely more than 0·00039 inch in diameter—which are of volcanic origin, and are well described by Thoulet as "the ultimate stage in the modification of submerged matter under prolonged contact with sea-water."

The mineral substances found in marine deposits have their origin not only in the detritus brought by rivers and by the erosion of the coasts; they are also derived from volcanic and other dust spread over the surface of the sea by the wind.

Thus we learn how the humble pebble plucked from the shore passes slowly to the depths of mid-ocean; and how, first by the action of the waves, and later by chemical processes, it is broken up to form clay.

Again, the mass of organisms living and dying in the ocean supplement these deposits by the decomposition of their skeletons or their shells, which were themselves formed of materials derived from the land. Masses of rock are sometimes found in the lowest depths, and their presence is due either to icebergs which have carried them out to sea and dropped them, or to recent submarine disturbances of the Earth's crust.*

Biology.—You now know in its broad lines the physical and chemical conditions of the liquid masses of the ocean; I will attempt to give you an idea of its organic life, such as we have learned to know it in this medium after long and difficult researches which have not yet said their last word. Haeckel has made a useful division of the inhabitants of the sea into two classes: all those which move freely between the surface and the bottom he calls *plankton*; those which live on the bottom, whether actually fixed to it or not, he calls *benthos*. Hensen has attempted to gauge its mass, but our knowledge of the different levels does not yet seem to be sufficiently advanced to give complete results. So far from being uniform, the distribution of organisms is limited by conditions of density, temperature, light, and pressure. Even in mid-ocean the inhabitants of some levels alter their position at different times of the day, probably under the influence of the sun.

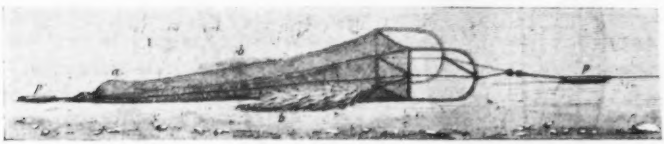
Much remains to be done before science can state the laws whereby the different species have become adapted to the ever-varying conditions. Because the animals of the *plankton*, from the whales to those of microscopic size, form species and genera of a number which it is not yet possible to determine: we discover some every year, either by inventing new instruments, or by exploring great depths more thoroughly.

First there is the trawl, varying in size according to the power of the ship. This consists of a large bag, provided with a guard to imprison all the animals which enter. Inside are hung some large swabs, while others are heaped on the bottom to protect fragile animals from damage caused by trawling, stones, lumps of mud, or the heavy carapaces of larger animals. Others, again, are hung outside, to entangle in their yarns such animals as sea-urchins, holothurians, sponges, crustaceans, etc., which are often found in them in a better state of preservation than inside the trawl. To manage the trawl, I have, on the *Princess Alice*, over 6000 fathoms of steel cable in a single length. The diameter of this cable is increased at every 2000 fathoms, in order that, in working at great depths, it may economize strength required to sustain its own weight. The breaking strain of the inner portion is 7 tons.

The trawl brings up the greatest number of individuals and of different species in every group, especially in those which, like the

* Most of the data laid down in this first part of the lecture, when their origin is not plainly mentioned, are the views of Murray, Buchanan, or Thoulet.

corallines, are fixed to the bottom; or in those which, like Echinodermata or Mollusca, can only move slowly, but it catches also a great number of fishes. I have used it down to a depth of 2944 fathoms. Amongst many interesting operations, I will mention here one of which I have retained a particularly vivid recollection. It was on the north coast of Spain, not far from the greatest depths of the Bay of Biscay; the trawl came up filled with crabs of the size of mice, armed with very sharp claws, of which they made a use which seemed exaggerated. They are called *Polybius Henslowi*, and the net had taken them in coming up, because they live in intermediate regions. By weighing a portion of this mass, we learned that there were 5000 individuals, although



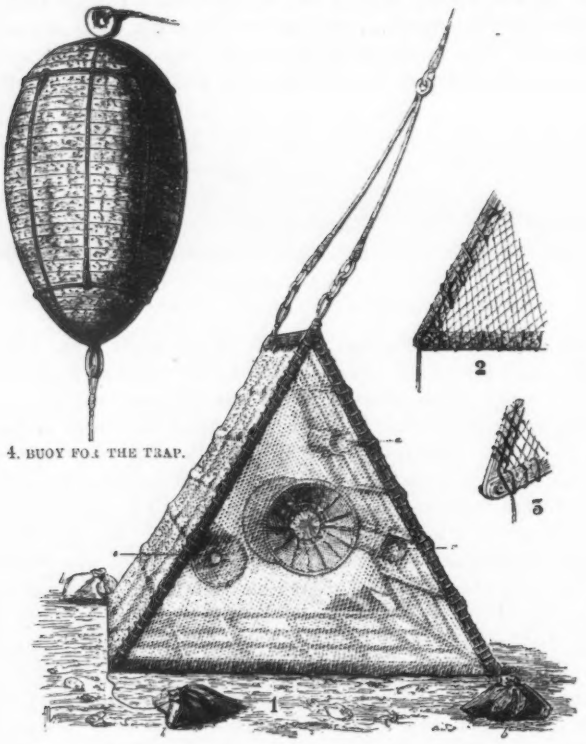
BOTTOM DREDGE.

the net was torn in several places. They could run with great rapidity, and spread all over the yacht; for several days we found them in every hiding-place, even in our pockets and in our boots. Another experience served to confirm the belief that there are no roses without thorns. The trawl brought up, with a host of other treasures, a certain sea-urchin, the sight of which roused me to enthusiasm, for it was different from any species known to me. I at once laid hands on it, and received a prick from one of its spines. For several hours I suffered the most acute pain I have ever known; this was probably the first discovery of a poisonous stinging sea-urchin, and I shall not forget it.

One day it occurred to me that there must be some lively animals in the deep water which would not be stupid enough to get caught by a bag dragged across their territory in a cloud of mud, and I had the idea to send down to these supposed creatures, something into which they would enter voluntarily. It took the form of traps baited with the most delicate morsels which we could offer, such as salt fish, sheep's offal, or the intestines, heads, and claws of fowls. Sometimes we even soak these viands in a sauce made of assafœtida, which seems to have an attraction for some marine animals, proving once more that there is no accounting for tastes and colours. I always have some bright objects hung amongst the bait suspended in the trap, such as bits of looking-glass; these are especially attractive to Crustacea, though I have not yet observed that this applies particularly to those of the fair sex. The traps are large enough to hold four or five people, and are made of netting and wood, being so simply constructed, that we can make them

ourselves on board. As they are pentahedral in shape they always lie well on the bottom, no matter on which of their principal surfaces they fall.

Among animals, as among men, the stronger devour the weaker, a reflection which has forced itself on me more than once on picking out of my traps the heads, tails, fins, or antennæ of animals which had been devoured by others stronger than they, before the latter saw that they



POLYHEDRIC TRAP. 1, GENERAL VIEW: *a*. SMALL NETS INSIDE THE LARGE; *b*, BALLAST BAGS. 2 AND 3, THE ENDS OF CONDUCTOR.

were themselves prisoners. It occurred to me one day to put smaller traps inside the large one, to serve as shelters for the feeble and the hunted; by this means many innocents have been preserved—in the interests of our laboratory. It is, however, also true to say that with animals, as with men, the weak often collect together in vast numbers in order to paralyze a single stronger individual, and overwhelm him without risk to themselves. Thus in the Bay of Biscay, a trap sunk to

a depth of 1455 fathoms brought up a dog-fish 32 inches long, which collapsed like an empty bag when laid on the deck; its soft parts, muscles, and tendons, weighing at least 8 lbs., had been completely devoured in the space of twenty hours at most by minute crustaceans, many of which came up in the little traps, while others were still enclosed in the bag which they had made out of their prey. Does it not seem as if we men, who, for the purposes of our political life, exploit the passions, the weaknesses, and the quarrels of our fellows, have sought savage examples in these depths? The best lesson taught by science will always be, How vain is the pride of man!

The traps are lowered to the bottom by a cable smaller than that of the trawl, composed of twenty lengths, each 277 fathoms long, and detachable at the point required by the depth. The detached end is made fast on a buoy of greater or less power, and the whole sent overboard, with a flag visible at as great a distance as possible, so that the apparatus can be easily found.

But an operation of this nature presents many complications, and I had to spend several years before I had rendered it easy. While the apparatus is descending, the cable, which has a density higher than that of the trap, must be paid out at such a rate that it shall not sink more quickly than the pot, otherwise the operation would terminate in irreparable disorder. Further, when the trap arrives at the bottom, the ship must be kept at rest vertically over the cable, in spite of wind, or current, or sea, during the time required for detaching the length of cable paid out from the reel, and attaching the end to the buoy; for if the trap were dragged over the bottom, especially in rocky ground, it might be seriously damaged. Again, it is important not to lose sight of the buoy, because, if bad weather were to come on, and astronomical observations should be impossible for some days, one might be detained indefinitely in the region. I have, therefore, adopted a system of lighting by means of very powerful lamps, which are fixed to the signal mast, sometimes to the mast of a boat, which is moored to the buoy. In this case I can keep it in sight all night.

I have, however, had many annoyances in the course of these operations. One day I had let down my trap in the middle of the Bay of Biscay, in 2777 fathoms of water, without remembering that I was in the track of steamers going from Northern Europe to the Mediterranean or Africa. In the evening, as we were watching with satisfaction the swaying buoy with its brilliant illumination, a passing steamer altered her course to see what this light on the surface of the water could be, for no fishing-boats come so far from land. Shortly after a second steamer did the same, led by the gathering of lights to suppose that a disaster had occurred; and, finally, a large liner also stopped to make inquiries. The swell was heavy, and I dreaded a collision, for we were like moths round a lamp; it needed some care to keep ourselves clear,

but we managed it, and these curious vessels never understood what it was all about.

The traps have brought me many interesting creatures, which I have got by no other method. Notably last year a new amphipod of great size entered, along with a fish and other crustaceans, one of these traps, which I had sent down to a depth of 3000 fathoms, in a deep

SHOWING THE TRAP ON THE BOTTOM, WITH BUOY AND FLOAT ON THE SURFACE.

basin situated 500 miles south of the Azores, to which the *Challenger* Commission had been good enough to give my name. *A propos* of this, I may say that my flag has actually floated over this colony, acquired for my country, because I flew it for twenty-four hours on the buoy, which was in direct communication with the ground. Seldom, I will add, has a colonial expansion been achieved under conditions less dangerous to the peace of the world; and no one has as yet protested against my attempts on this territory placed 3000 fathoms below the surface of

the sea. Besides finding creatures new to science, my traps have enabled me to demonstrate the abundance of life in some parts of the great floor of the sea. Thus, last year, one of them placed in a depth of 700 fathoms to the south-west of the Azores, brought up 1198 fish, called *Symenchelys parasiticus*, a species very little known before my researches with the traps, which exists only in one or two collections. Analogous cases met with in other places make me think this fish is one of the most widely distributed animals in great depths, at least between 300 and 1600 fathoms; it would also be one of those having a vertical range of greatest extent.

Near certain islands of the group of the Azores, a trap brought up sixty-four crabs of a new species, named *Geryon affinis*. These are of enormous size, and some which had not found the mouth of the trap when it began to rise, actually made the journey voluntarily on the outside of the apparatus, and were still clinging to it when it was hoisted on deck. What motive could have induced these animals to face the dangers of such a voyage across spaces of continuously decreasing pressure, the temperature of which rose at a rate extraordinary for them, whilst the light of the sun blinded these creatures, accustomed only to the pale glimmers of phosphorescence?

As they are fitted only for walking, and in no way for swimming, I imagined that they must have experienced all the doubts and terrors of a man whom the ascent of a balloon has surprised, still holding on to some accessory of the car, and who has hesitated at the first moment to let go. Such a mishap could never happen to *Polybius Henslowi*, the swimming crabs of the Bay of Biscay, of which the trawl made me such a magnificent present.

During the last two years I have tried in deep water an instrument which gives the best results as regards the variety of species it brings up on the inshore fishing-grounds;

SYMENCHELYS PARASITICUS, GILL (400 TO 1000 FATHOMS. AZORES).

this is the trammel. This net, several hundred yards long, must stand vertically extended on the bottom by lead along its foot rope, and cork along its headrope. The animals, while trying to cross through it, make a pocket for themselves and are caught.

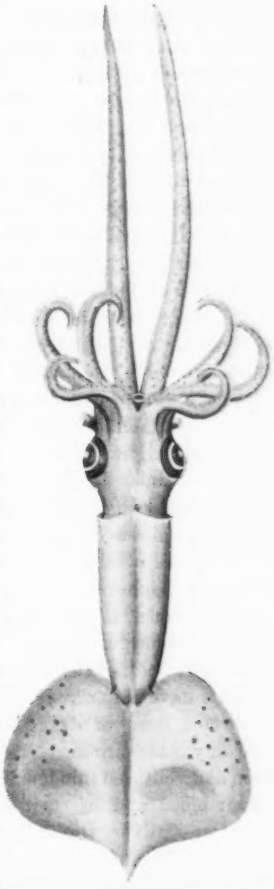
But I have experienced great difficulty in sinking properly and to a sufficient depth these nets, which are very fine. This is how I proceed: A first cable is anchored to a weight of 200 lbs., and supported by a buoy. The ship then moves away to a distance equal to the length of the trammel, then a second cable is sent down to the bottom with a weight equal to that attached to the first. A boat carrying the net now goes to the buoy in order to fix the end of the trammel to a ring, through which the cable is rove and is held by a line made fast to the buoy. The boat now returns towards the ship, putting over the net and keeping it as well stretched as possible until the other end can be fixed in the same way to the second cable. A signal is now given, and a boat at the buoy lets go the ring of that end at the same moment that the ship lets go the ring at the other end, and the net sinks quietly. To minimize the risk in taking up, the ring which passes down from the first buoy is kept down by the weight, while the ring on the second cable is wide enough to clear the corresponding weight; thus the only function of the second cable is to stretch the net taut on the bottom. As soon as we suppose the net has reached the bottom, the guide-rope is hauled in, and the first rope alone left attached to the apparatus.

The trammel-nets have already given me very good results, notably squales of considerable size, but it can be imagined how complicated the operation becomes when carried out at depths of 1500 fathoms, especially if bad weather comes.

But you will, no doubt, have wondered more than once if it never happens that heavy and cumbersome articles, such as the trawl, the trap, or the trammel, do not break the cable which holds them, by hanging upon some obstacle on the bottom, or simply by their own weight or resistance. Unfortunately it is so, and I could tell you of accidents of the kind which have cost me thousands of fathoms of cable with all that it carried; but I have greatly diminished the number of accidents by means of an instrument through which the cable passes when it leaves the water in heaving up, and on the dial of which the tension at every instant is indicated. If the strain becomes excessive, cable is immediately let out, and the ship suitably manœuvred. For example, when a trawl catches on the bottom, the yacht steams round it in circles, which may be miles in radius; in this manner strain is put on the cable at various angles until the obstruction gives way, or we are reduced to a last effort to break it at a weak spot, provided for on purpose, near the trawl. Notwithstanding every care, it happens that the cable breaks at an intermediate point.

These are the chances in a struggle which I always return to, and in which I have embarked all the energy of my being for the last fifteen years. We have, however, special forms of instruments for dredging on rocky bottom, where a trawl would certainly be lost. These are bars of soft iron fitted with swabs. The oakum, in passing, hooks everything that is thorny or angular, such as corallines, sponges, hydrozoa, echinoderms, crustaceans. Sometimes even an over-bold fish pays for its curiosity; it remains hooked by its teeth or its fins.

The intermediate regions between the surface and bottom of the sea are the most difficult to investigate, because their inhabitants are undoubtedly good swimmers, very suspicious, and already provided with abundant food. Further, if we would know precisely the level at which an animal brought up by the net was caught, it must be possible to open and close the net at will. At present only one trustworthy method of doing this has been invented, and it is not easy to make the opening more than a few feet wide; that is to say, very large animals cannot be taken. We have already learned from its use, however, that a whole world of fishes, molluscs, annelids, medusæ, cephalopoda, and crustaceans come to the surface at night, and return before day to a depth of some hundreds of fathoms, forming a living tide which ebbs and flows in every sea.



CHIROTEUTHIS GRIMALDII, JOUBIN (AZORES. 750 FATHOMS. REMARKABLE FOR ITS THERMOSCOPIC ORGANS PLACED ON ITS FIN).

Experience enables us to recognize broadly whether any given creature comes from the bottom or from an intermediate depth. Those which are never found on the surface or on the bottom, generally show a crystalline transparency and low specific gravity.

For reasons connected with temperature, some fishes live at variable depths. The Norwegian scientist, Mohn, found lately that the occasional disappearance of codfish from certain parts of the Norwegian coast was due to the fact that these creatures follow a zone of a particular temperature,

in which doubtless they find their food. If the fishermen had let their lines go a few fathoms lower, they would have found cod in abundance. Mahn taught them the value of searching for the shoals with a thermometer. The periodic disappearance of sardines from the coasts of France is doubtless partly due to similar circumstances. These fish live on very lowly organisms of minute size, called Peridinia, the habits of which are probably largely influenced by temperature. In investigations on the sardine, made by us off the Spanish coast, MM. Pouchet and De Guerne found in the intestine of a single fish a number of Peridinia which might be estimated at twenty millions, without counting those in the stomach and œsophagus. It is certain that in the case of sardines, as in the case of whales, feeding is an unconscious process, consisting simply in the fish swimming about with open mouth, and existing on a prey the size of which they cannot appreciate. If we watch the phosphorescent surface of the sea in the early part of the night in mid-Atlantic, we often see, as it were, a vast and permanent fan, opening out ahead of us in lines of fire. These are shoals of fish, which run away from the advancing ship, the species of which remains a mystery, in spite of all attempts to catch them, and in spite of their incalculable number. We have often steamed or sailed through them for a whole night.

Several times, in about 48° N. lat., we saw, in spite of the obscurity of the night, a vast field, quite black, that the undulations of the swell rendered luminous when they made the elements of it oscillate. These were millions of medusæ (*Pelagia noctiluca*), each of them carrying a powerful phosphorescent brightness under their cupula.

It has come to our knowledge, almost as it were by chance, that some of the larger species herd together in great numbers far below the surface, and far also above the bottom. Early in the morning, before the birds have begun searching for their food, we often find, floating on the surface, dead or dying animals of species we are unable to procure under any other circumstances. Ought we to see there deep-sea species, which had ventured into levels too high for the pressure of gases contained in their blood and in their swimming-bladder, and had been suddenly carried upwards by the expansion of these gases? This idea suggested itself to me because fish caught at great depths in my traps float at the surface like balloons, their stomachs being sometimes pushed forward out of their mouth by the dilatation of their swim-bladders. On the later expeditions I have hunted the large cetacea, because they seek their food among this bathypelagic fauna, and we often find in their stomachs entire specimens of the animals mentioned. The sperm whales, grampuses, globicephalus, and orca, or other large creatures, have thus constituted my private falconry, although they have not always shown a very nice temper.

We must fire at them harpoon guns to make them abandon the

contents of their stomachs, and we witness then formidable vomitings in the middle of which surprising animals are ejected in a large pool of blood. Nearly all the animals obtained are new, or at least extremely rare.

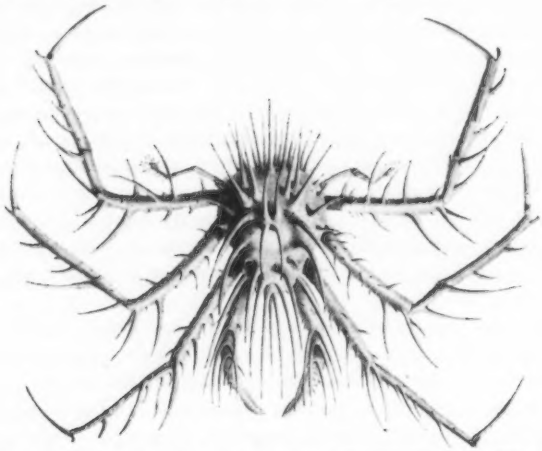
Giant cephalopods constitute almost entirely the spoils of these combats, where we find, besides, very rough adventures. And if I estimate the quantities of these animals spread over the regions that we explore with such difficulty, by what I see on such occasions come out of stomachs filled like barracks, I conclude that they must be the masters of entire kingdoms. The most remarkable that I got by this somewhat violent proceeding is the *Lepidoteuthis Grimaldii*, which cannot be classified under any known species, genus, or even family of its order. It was vomited by a sperm whale in 1895, under the stern of the ship, but had, unfortunately, been decapitated during the violent scenes in which it had lost its life. One could hardly reproach it for that. The body is trumpet-shaped, with a circular fin, and the visceral bag is covered with large prominent scales, arranged in spiral lines, and forming a protective cuirass.

The same sperm whale gave us a *Cucioteuthis*, another immense cephalopod, with arms as strong as a man's, and carrying suckers armed with claws as powerful as those of a tiger; this animal is furnished with luminous organs. In 1897, a large cetacean I was attacking with a whale-boat, vomited a large fragment of another cephalopod, which was peculiar in being of a viscid substance not unlike glycerine; no net could retain it, and we only secured it by "dipping" it up with a large tub, with all the water surrounding it.

Besides the cetaceans, other less formidable animals assist us in collecting samples of the bathypelagic fauna. The tunny fish, which I have found widely distributed over the North Atlantic, feed far below the surface, and their stomachs yield small fish, cephalopods, crustaceans, and pelagic molluscs. They are caught by means of lines towed behind the ship when steaming at a moderate speed, the single hooks being baited with a cephalopod made of maize leaves. So as to be surely warned when one of them is taken, we attach the line to the spring of a bell, whose resistance yields to the weight and to the efforts of the tunny, and which rings then vigorously. Therefore, among all the inhabitants of the sea who pay a visit to my laboratory, this is one who makes his entrance the most correctly.

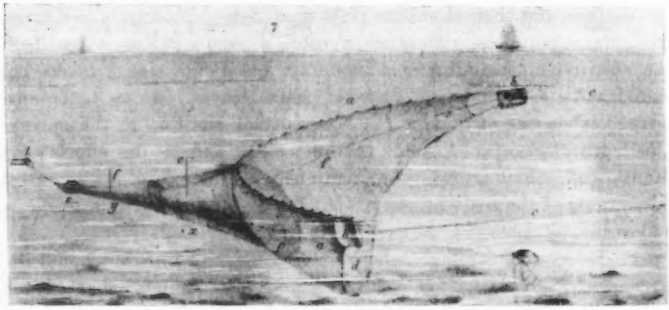
There are some animals whose forms can show how much nature is capricious in distributing beauty among the beings that she has relegated to the depths. *Halosauropsis macrochir*, from the deep water at the foot of the Azores plateau, carries luminous organs on twenty-five scales placed along the lateral line on each side of its body—real lanterns, of which the light can be hidden at will by means of an opaque black membrane. This fish was known before only by some imperfect

specimens. The *Photostomias Guernei*, which is new, is also provided with luminous organs, two on each side of the head, and two lines of them along the body; it was obtained near the Azores, at a depth of 620 fathoms. Off the bank of Newfoundland, at 690 fathoms, we got a new crustacean, *Neolithodes Grimaldii*, with a bright red body protected by formidable rows of spines on the carapace.



NEOLITHODES GRIMALDII, M. EDWARDS AND H. BOUVIER (NEWFOUNDLAND. 650 FATHOMS).

The small surface forms which cover the sea during the night are collected in vast numbers by means of a large floating net, composed of wide-meshed wings kept open by a wooden plate attached to the end of



SURFACE DREDGE.

each; a silk body of finer mesh; a bottom of the finest silk gauze; and, lastly, a zinc bucket, in which the fragile catch accumulates and is protected. When this apparatus is towed along at a speed of about 1 mile

an hour, it sweeps the sea with an opening 9 or 10 yards in width, and acts very much in the manner of a net called otter-trawl. At the end of half an hour it usually contains a pulpy mass sufficient to fill a large basin, from which it is strained through silk funnels, and preserved with suitable reagents. Of the remarkable forms obtained in this manner, none has impressed me more than a rare annelid several inches in length, which is so transparent that when placed in a glass basin under the rays of a powerful electric lamp, its presence can only be detected by the disturbance its progress creates in the crowd of other animals: it is discovered, as astronomers discover a star, by the perturbations it brings in its neighbourhood.

There is quite a world, perhaps that of the æsthetes of the sea, which obeys the seductions of artifical light when, on a dark night, I light up the surface of the ocean with an electric lamp. Thousands of creatures rush then as if to bathe themselves in the rays, and again I reap an abundant harvest.

There are also numerous brotherhoods very practical, to which one belongs on the condition of living only by somebody else's work: those of the parasites. They include representatives of most of the great sea-families, and show much intelligence in selecting advantageous positions to catch the best morsels, and much philosophy in accepting the necessary drawbacks to their mode of life. One would say that they have observed men in their most refined manner of exploiting one another.

Certain isopod crustaceans inhabit the mouth of *Synaphobranchus pinnatus*, a fish found by us in great numbers on the bottom of the Atlantic. They live there sentimentally, in couples, husband and wife I hope, seated one opposite the other near the gills. Their life is passed in a tranquil happiness, in choosing what pleases them of the quite fresh food of their host, and in regarding outside when the latter opens his mouth. At last they grow so fat that the fish can no more close his jaws. How many people do no more than that!

Other parasitic crustaceans prefer a situation which is better protected from accidents from the front; but they have to be content with very light nourishment, for the powerful digestion of a turtle leaves but little for them. Still other parasites penetrate to the internal organs of their hosts: helminthes inhabit the liver, the stomach, or the intestines of their victims; and there are fishes which inhabit the interiors of certain holothurians and medusæ. We recently discovered a *Copepod gallicole* which, if lazy, is at least not greedy; it inhabits the outside of the shell of a sea-urchin. An elongated crustacean plants himself in the cornea of the sunfish's eye, protruding his ugly person therefrom. It is not that one that I should advise you to choose if you had to replace the parasites which actually find their delights in humanity.

Between the parasites, properly called, which live on the substance

itself of their host, and the messmates who content themselves with gnawing something from his repasts, the number of the animals governed by this *régime*, of protectorate more or less confined, is so considerable that I cannot speak to you more of them without finding myself led much too far. So I will limit myself now, announcing to you an observation of general interest while the doors are opening themselves to put you at liberty.

My investigations have proved that an abundant fauna inhabits the surface waters of the sea both by day and night; also the thought has struck me very often how many shipwrecked people who died of hunger after having wandered in their boats, might have been saved if they had known this fact, and possessed the means, very simple, of procuring some scraps of this fauna. As we have just seen, tunnies can be easily caught by means of a line carrying a rough artificial bait. Floating spars, casks, driftwood, and the like, attract shoals of fish, especially when they have become well covered with attached organisms. I have caught fifty *Polyprion cernium*, weighing 308 lbs., from a shoal in less than half an hour. The spar they were following might have served a shipwrecked crew as larder for a week. Once we harpooned a moonfish weighing nearly 650 lbs., which would have capsized my boat if I had not been able to immediately take a turn with the line round the spar. On another occasion, when out in a small dinghy, I was capturing again polyprions—and with great satisfaction, for we had just rescued a crew of shipwrecked English sailors, whose ship had sunk before our eyes, and were at the time short of provisions ourselves—when a shark twice as long as our boat appeared, raised his body and looked at me with his cruel eyes, and then settled under the boat, rubbing his back against the keel. Fortunately, I resisted a first impulse to provoke a combat which would have been very unlikely to end in my favour, and made direct for the ship, escorted for some distance by the monster.

There is no very obvious explanation of the fascination any floating or drifting object seems to have for marine animals of all sorts. I have often observed it as well with turtles, whose brains are very poor, as with large cetaceans, whose intelligence appears relatively powerful, and which obey the attraction of a buoy or even of a ship, at least the species which have not yet been scared by whalers. Any kind of apparatus brought up from the depth, even a cable-end, is often accompanied by single fish, or small companies, which get hopelessly bewildered when the object disappears out of the water. Meanwhile we content ourselves with stating the fact, and adding the suggestion that all ships' boats should carry a harpoon and lines, or similar tackle, for keeping up the supply of provisions.

I feel a sentiment of true sympathy in relating all these things to an English audience, to give them an idea of our efforts, for England has always furnished great examples to sailors. It has also given me a

collaborator extremely useful and devoted, in the person of Captain Carr, of the Naval Reserve, who shared with me for seven years the labours of which I have just given you a sketch in rough outline.

Before the reading of the paper, the CHAIRMAN (Sir Charles Wilson) said: We are honoured this evening by the presence of H.S.H. the Prince of Monaco, who has very kindly come here to give us the result of his work during the last fifteen years. Every year His Highness devotes from two to three months to the examination of phenomena connected with the ocean, and his labours have resulted in valuable contributions to the science of oceanography.

After the reading of the paper, the CHAIRMAN said: Before asking you to return a vote of thanks to H.H. for his interesting and valuable paper, I will, with your permission, read a letter from the Swedish minister to Sir Clements Markham [printed in June number]. I can only say that I hope our own Government will join in this useful work. What the Prince has said to-night shows us that we have still much to learn with regard to the habits and food of fish. It is so late that I will not invite any gentleman to discuss the question, but will ask you at once to return a very cordial vote of thanks to His Highness for his paper. We must all wish that the new *Princess Alice* may be as successful as her predecessor has been, and I feel sure that in a few years' time we shall have results more valuable than those that have been communicated to us this evening. There is one point to which I should like to allude. I believe that most of the traps and the different instruments that we have seen on the screen this evening have been elaborated by His Highness himself and by members of the very valuable staff which accompanies him on these expeditions. I trust that you will allow me to thank His Highness very cordially in your name for having presented the results of his voyages to us in such a pleasant manner. I am glad to find that his voice has lasted so well throughout the evening, and I may add that we have all been greatly pleased and delighted with the fluent English in which his communications have been made to us.

EXPLORATION ON AND AROUND ACONCAGUA.*

By E. A. FITZ GERALD.

THE High Andes of Argentina, in the province of Mendoza, run, as you all know, north and south, in three great ranges parallel to one another. The western range forms the water-parting and boundary between Argentina and Chili, while the centre range contains the highest peaks. The eastern range is divided from the centre range by a wide and flat plateau at an altitude of about 4000 feet above the sea, known as the Uspallata valley. Aconcagua is situated in the centre range, about 5 miles east of the water-parting. Though the mountain itself can be plainly seen on a clear day from the Pacific coast, yet all the snow and water that falls on this huge mass drains off to the South Atlantic

* Paper read at the Royal Geographical Society, March 28, 1898. Map, p. 552.

ocean, some 700 miles distant. The object of our expedition was to climb Aconcagua, if possible, and to find out accurately its height, as well as to map as much of the surrounding country as we could. Several attempts to climb this mountain had been made, among which I would most particularly cite that of Dr. Güssfeldt, who attacked Aconcagua from the north side. This eminent German explorer was unfortunate in losing his guide, who fell ill in Valparaiso, and he was thus handicapped and compelled to attempt the ascent with a mere boy; he, however, did much in elucidating the geography to the north of the mountain, and also climbed the extinct volcano San José de Maipu in the south. Besides myself, our party consisted of Mr. Vines, Mr. de Trafford, Mr. Philip Gosse, my guide Zurbriggen, and five porters that I had engaged in Switzerland. I should here add that Mr. Lightbody, one of the engineers of the Trans-Andine railway, joined me soon after I arrived in South America. We left England on October 16, 1896, and arrived at Buenos Aires three weeks later.

Our work was almost entirely confined to the Argentina or eastern side of the water-parting. Our equipment and luggage, amounting to some eight tons in all, we took from London to Buenos Aires by boat, and thence on by rail to Mendoza, the last station of the Argentine Great Western railway. It is from this point that the Trans-Andine railway starts. While this was being done, I took the opportunity of visiting the observatory at Cordova, and testing all our instruments carefully, including the aneroids.

We all assembled in Mendoza, where we procured a troop of some twenty-five mules and horses, and then travelled up to Punta de las Vacas, the terminal station of the Trans-Andine railway.

It was, and is still I believe, the intention of the promoters of this line to run it through to Santa Rosa de los Andes, in Chile, there to join the government railway. There is as yet, however, only 75 miles finished on the Argentine side. The Chilian part has been constructed as far as Salto del Soldado, a matter of some 18¼ miles. There remains, therefore, some 44 miles to finish. This, however, will be the most difficult portion of the line to construct, as it will involve a tunnel under the Cumbre pass, the summit of which is 12,795 feet above sea. The line is a metre gauge, with rack and pinion for the steeper grades. It is much on the same principle as the railway from Visp to Zermatt, in the Swiss Alps.

The first few weeks of December we spent in reconnoitring the Vacas and Horcones valleys, so as to decide upon the best side from which to attack Aconcagua. We finally decided to try the Horcones valley, as it was the shorter, and the river was better for fording purposes.

The lantern slides I propose to show you later will, I hope, give some conception of the extreme dreariness of the region. What little

vegetation there is about the lower slopes of the valleys ceases above 12,000 feet. Roughly speaking, no rain falls during the summer months, so the herbage is confined to places near river-beds and close to natural springs. The most terrible winds prevail during the dry season, and sand and dust fly about in a way that almost blinds one. The wind rises, as a rule, about two hours after sunrise, and continues till just upon sunset. It can be easily imagined that, with such conditions, any work with theodolite or plane-table is extremely difficult. The fine sand flies into the verniers of one's instrument, and scratches the

ACONCAGUA FROM THE EAST.

plates terribly; while anything in the way of a sketch with a brush is out of the question.

We first turned our attention towards exploring the Vacas valley. Accordingly, Zurbriggen and I started on the morning of December 9, 1896, to ride up it. We had our first experience of fording Andine rivers here. Throughout our work we found this one of the most difficult and dangerous obstacles to overcome. In the afternoon, when the sun has melted the snow from the sides of the mountains, the rivers rise to such an extent that it is impossible to cross them. They have to be negotiated in the early morning, or after eleven at night, when, owing to the frost, the water begins to subside. The Vacas valley, as we found afterwards, is one of the most fertile in this region. We were, however, at the time ignorant of that fact, and I must say it seemed to us about the

most desolate spot imaginable. It was not till the second day that we reached the head of this valley. The upper part of it is flat and wide, there being no vegetation—nothing but a dreary vista of yellow sand and stone, the only relief from this being the multi-coloured stratification of the rocks on the surrounding mountains. From here we saw a great peak towering to the west of us, but at the time we were uncertain what mountain it was. Afterwards we found out that this was the Aconcagua, though our native mule-drivers stoutly denied it.

On returning to our camp at Vacas on the following day, I decided to make a trip to the Horcones valley, where, it was said, a great mountain was visible, supposedly a spur of Aconcagua. The native people of the Andes are vague in their ideas as to where the mountain really is, and I have never met a mule-driver, or arriero, as they are called, who would admit that any peak was really Aconcagua. They say it may be a rib or spur leading to a buttress of what might be a peak *near* to Aconcagua, but nothing more.

We spent the next few days in moving our base camp to a spot near the mouth of the Horcones valley, close to Puente del Inca. This we considered would be the most central point from which to base our operations for the attack on Aconcagua.

Upon December 23, I started with Zurbriggen and four of the men acting for me as porters, viz. Louis and Joseph Pollinger, Lochmatter, and Lanti, together with two horses and ten mules, to make an attempt upon our mountain. I had previously sent Zurbriggen up this valley to see how the land lay, and he had reported to me the possibility of taking animals to the head of the valley. From here, he said, one could easily reach the north-west shoulder of the mountain, and form a camp at about 19,000 feet. This, we thought, would make a good starting-point for ascending the peak.

After the first 12 miles up the Horcones valley the pasturage ceases, and the aspect of the country assumes that of a vast wilderness of sand and rock, the valley being blocked in places by the remnants of huge moraine heaps. The first time we rode up this valley we had great difficulty in getting our animals through, as there was of course no track. Later on, we constructed a pathway over the most difficult and dangerous places, and thus saved ourselves much trouble and danger. We reached the head of the valley upon the same day that we started from Inca. It was about 14,000 feet high here, and we found it impossible to take our animals further, owing to a great glacier that fills the head of the valley; so, after selecting some things from our luggage, we sent our animals back to the base camp at the mouth of the valley. We then pushed forward on foot to an altitude of about 16,000 feet, where we slept for the night. It was at this point that we had our first experience of mountain sickness. The day had been a hard one, and the mid-day sun powerful, so we were reduced to such a

state of collapse by the time we got to our proposed camping-place that we were unable to put up our tent. We crawled into our sleeping-bags side by side on the bare unsheltered mountain-side, among loose stones and rock, and attempted to get what rest we could, totally unable to shelter ourselves from the wind which raged about us. None of us slept for long, and Lochmatter, one of our porters, was very ill during the night. As dawn came the weather got intensely cold; even in our bags we were unable to keep warm. As soon as the sun touched the tops of the mountains opposite, we tried to prepare a little warm food. This we found impossible, owing to the apparatus we carried for heating our food having struck work. It had been thoroughly tested in

SOUTH-EAST PRECIPICE OF ACONCAGUA FROM GLACIER.

London before our departure, but either the spirit was bad, or the rarefied air gave an insufficient supply of oxygen.

As we learnt from subsequent experience, it was a great mistake attempting to do anything till the sun had actually risen over us. The great mass of Aconcagua being directly to the east, and rising at an abrupt angle, the sun did not strike our camp till about two hours after its rise. Meanwhile we got thoroughly chilled, and, being unable to get any hot food, we were all practically incapacitated for reconnoitring. The result was that the whole day was spent moving our camp some 1000 feet higher, and getting more provisions from the camp below. We succeeded in getting our little tent pitched at about 17,000

feet, and spent the night there. After twelve miserable hours spent in a very cramped place—for our tent was only 6 feet square, with a sloping roof ending in a peak 4 feet from the ground—we crawled out upon Christmas morning. One man made a feeble attempt to greet me with a "Merry Christmas;" I, however, replied that to my mind it was *not* a merry Christmas, and that was the last word upon the subject.

As we were still in need of several things, I thought it best to send a man down to our lower camp, that he might bring up some provisions and equipment, while I spent the day in making an excursion higher up to look for a suitable place to move the camp to. Being unable to cook anything, we were reduced to eating some tins of Irish stew cold, slowly melting the lumps of white frozen grease in our mouths. The natural result of this was violent fits of nausea.

It was with great difficulty that Zurbriggen and I climbed up during the day to an altitude of about 19,000 feet; we were fortunate enough to find, on our way, a sheltered spot under a hollow rock, where we could pitch a tent. On returning, I decided to move the camp there on the next day. This we accordingly did, and at an altitude of about 18,700 feet made our permanent base-camp, from which all subsequent attempts to climb Aconcagua started. One of our aneroids at this altitude went down to 12 inches, the minimum to which they were graduated, and then ceased to act in a most unaccountable way; another worked fairly well, but registered about three-quarters of an inch lower than it should when compared with the mercurial barometer, allowing for the error by its Kew test. In the afternoon we got a first view of the South Pacific ocean, lying at our feet 100 miles distant. Although it was fairly warm in the sun, our maximum temperature in the shade was only 27° Fahr., that is, 5° below freezing. Our pulses registered about 120 to 130 beats per minute, intermittent and flighty, while our blood-circulation was extremely bad.

Zurbriggen went up some 2000 feet above the new camp, and came back completely exhausted, having suffered much from the wind and cold. During his scramble he had espied a heap of red stones, evidently built by some one. On closer investigation, this proved to be Dr. Güssfeldt's last cairn. It was at this point that the well-known German explorer—night coming on, and the cold being intense—was obliged to turn back, literally to save his life. We passed a most miserable night at our high-level camp, and as we could not get the spirit in our cooking-stove to burn, we were obliged to content ourselves with cold food again. I decided, therefore, to turn back next morning, as I saw that the only chance of accomplishing anything at this altitude would be by bringing up wood, so as to enable us to cook proper meals. We accordingly retreated to our 12,000-feet camp, situated in the Horcones valley, some 12 miles from the Inca. On December 30 we again came up to the high-level camp, and between this date and January 2nd, made

two attempts to scale the mountain. The first time we failed, owing to Zurbriggen getting his feet severely frost-bitten. The second time I was obliged to turn back, owing to extreme weakness and nausea. Finally, we were obliged to retreat to our old camp, and spent a couple of days down there. On the 5th we returned to the attack, making a fourth attempt on the 14th. This time I succeeded in reaching an altitude of about 22,000 feet. We had been stopping for the last few days at our highest camp, and had suffered intensely from cold and want of sleep. On reaching this point (22,000 feet), I found that it was absolutely impossible for me to proceed further. As it was late in the afternoon, I sent Zurbriggen on at once to complete, if possible, the ascent, although myself obliged to turn back. I had the greatest difficulty in crawling down; my knees were so weak that I repeatedly fell, cutting myself with the sharp stones that covered the mountain-side. I crawled along in this miserable plight, steering for a big patch of snow. Here, unable to stand any longer from sheer exhaustion, I was obliged to lie down and roll down the mountain-side. As I got lower my strength returned, the increased pressure of the air seeming to act as a great stimulant. I returned to camp that night with one of the most severe headaches I have ever in my life experienced.

Zurbriggen arrived later on, and reported that he had reached the summit, but was unable to get any view, as a small local snowstorm raged over the peak during the afternoon. He was terribly tired and knocked up, and, though naturally elated at his success, he didn't really seem to care what happened to him during the night. He was also suffering from a severe headache. There was a most ghastly chorus of snores and men gasping for breath during the night, for at this altitude one is obliged to keep one's mouth open to breathe; the result being that the throat gets very dry, and when one stops for a moment to moisten it, a violent fit of choking is the result.

Next day we returned to our base camp at the Inca. On January 19, Mr. Vines and I, with a porter and mule-driver and some pack-mules, started to make another attempt upon the mountain. Zurbriggen was then temporarily disabled by the hardships he had undergone during his previous successful attempt. We bivouacked at 12,000 feet that night, and the next day we reached the 14,000-feet camp. On the 21st, Mr. Vines and I made an attempt to reach our upper camp, but I was obliged to turn back owing to illness. The next day (22nd) we again tried; this time, notwithstanding a tremendous gale, accompanied by a violent snowstorm, we succeeded in reaching our tent at nearly 19,000 feet. Here we spent two nights and a day alone, surrounded by a terrific snowstorm. As the wind had risen to a hurricane, the snow drifted tremendously, and we had a very anxious night, fearing every moment that our little tent would be buried beneath the volume of snow that drifted on to it. As soon as the weather had sufficiently abated, we

retreated as quickly as possible to our lower camp, reaching the Inca that night on foot in a blinding snowstorm.

On February 7 we made a fresh start, but, owing to illness, it was not until the 10th that we succeeded in crawling to the upper camp. The 11th and 12th were spent there, but as we were gradually getting enfeebled by the altitude, I thought that our only chance was to make an attempt at once. We did not seem to improve at these altitudes; on the contrary, we got weaker and weaker after every day spent there. On the 13th we, with an Italian porter, Nicola Lanti, made a final attempt to reach the summit. The day promised to be a fine one, so we left our camp at 18,700 feet in the morning. This time I was again obliged to turn back at about 20,000 feet, completely disabled, but I begged Mr. Vines to continue and make the ascent, if possible, that day, taking the porter with him.

He followed practically the same route that had been taken on our previous attempts. Aconcagua now wore quite a different aspect from what it usually does at this time of the year, the whole mountain-side being white with new snow. Zurbriggen had climbed the mountain almost without putting his foot on snow.

At mid-day Mr. Vines reached the spot where, on our first attempt, we had left some provisions and instruments. Up to this point things went fairly well with him, though his speed very much diminished as he ascended.

In order to reach a gully leading to the final ridge, he was obliged to cross a slope of loose stones that stretches over the north-western face of the mountain. Both he and the porter were now in a condition when the slightest rebuff sufficed to damp their spirits, and give them an excuse to sit down and rest. And these excuses were frequent, the whole ground being a steep slope of rotten stones, which gave way with them at every step, so that they were continually falling on their hands and knees. Mr. Vines had suffered very much from the biting keenness of the wind, so when he reached the gully that led to the peak, he hailed with joy the shelter it afforded. This in the end, however, proved more of a hindrance than otherwise, for in that gully, and, in fact, in all sheltered places, he found the labour of breathing greatly increased. He found it necessary to stop and rest at very short intervals now whenever the way was steep. Even on more level ground the rate of going was very slow.

These intervals of rest became more frequent as he ascended, and he found much relief in leaning forward on his ice-axe, keeping his head as low as possible. Zurbriggen's experiences were much the same at this height.

After about 300 feet the gully widened out into a huge amphitheatre filled with broken red rocks. In front was the rock ridge between the western peak and the summit. The summit was on the left, a cliff

running from it, while on the right high cliffs towered above him. This was certainly the most trying part of the ascent. After frequent rests, they reached the great rock ridge, and gained a first view of the country to the south. They both experienced relief on reaching this spot. There seemed more air to breathe than in the sheltered route they had come by. Clouds kept rolling up from the north-west, and were now nearly touching the second or western peak. The air was bitterly cold, the thermometer registering 7° Fahr., or 25° below freezing. The summit was observed to be in the shape of a square plateau, 75 paces each way, sloping at an angle of 7° towards the north, and entirely free from snow. Mr Vines found that Zurbriggen

HORCONES VALLEY, LOOKING SOUTH DOWN FROM HEAD OF VALLEY.

had built a substantial pyramid out of the loose stones lying on the summit. At the foot of this, after setting them, he placed maximum and minimum thermometers, leaving them sealed up in a tin case.

The western and north-western sides of the mountain fall away at an angle of 20°, and are composed more or less of great slopes of loose stones, which are kept clear of snow in summer by the winds that sweep them. To the south and south-west the sides are more precipitous, also fairly clear of snow and ice; but to the south-east there is an enormous precipice of nearly 10,000 feet covered with great overhanging masses of snow and ice, forming one of the most imposing sights imaginable. Looking down this dizzy precipice, Mr. Vines saw below him spurs of the

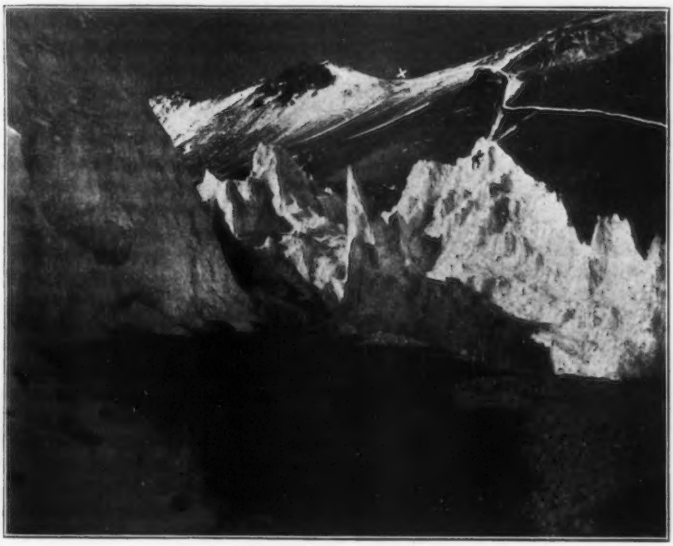
mountain flanking the glacier beneath to the right and left, giving it the appearance of a huge amphitheatre. The sun was now not far off the horizon, and did not penetrate into this vast pit. Great masses of vapour were moving about in it far below, giving it the appearance of some giant cauldron, it being almost impossible to see the bottom, 2 miles vertically below where he stood.

The sky was still clear to the north. To the north-west the line of the Pacific stood up high in the horizon, stretching away for over 150 miles. Range after range of mountain could clearly be seen between Aconcagua and the ocean. He seemed to look right down into the valleys between these ranges. The first striking feature to the north was the Val Penitentes, beginning in glacier, and stretching for 15 or 20 miles in a straight line to the north. Forty miles away, following the line of the Val Penitentes, stood the great snow mass of Mercedario, towering above all the surrounding ranges. The southern side of this peak is a gentle snow-slope, while the northern side would doubtless consist of slopes free from snow, as was the case on Aconcagua. Of the pampas or great plains of Argentina he could see nothing; there were too many ranges of high mountains between Aconcagua and Mendoza to make this possible. But to the south the clouds, fortunately, were not high enough to cut off the magnificent view of Tupungato, and the great range to the north of it, with the beautiful peaks of Pollera, Navarro, and Juncal, which so distinctly mark the boundary-line between the two republics. The eastern side of Aconcagua sloped down to the great bare wastes at the head of the Vacas valley, which ended in glacier. An easy passage for mules could be made over from here into the Penitentes valley, and so to the north. The clouds soon lifted in the Horcones valley, and cut off all possible view of Tupungato; other clouds were gathering round the western peaks. It was too late to remain longer—it was 6.30—and Vines did not relish the idea of being caught by night at such an altitude. As it was, they would have to rely on a clear moon for the greater part of the way. The descent to the gully over the great stones that lay everywhere was most exhausting, and they did not seem to derive any benefit from the increase of pressure as they descended. The descent from the ridge between the two peaks of Aconcagua to the camp was made in one direct line down the great slope of loose stones, and breathlessness and weariness seemed to continue to the end. They reached the camp at 8.30 p.m.

That night we experienced a very low temperature (3° Fahr.); after sunset the thermometer had gone down with a rush. Mr. Vines arrived with his beard and moustache a mass of ice, in which plight he remained all night. While waiting for their return, I watched a most glorious sunset. The whole Pacific ocean from north to south, together with the sky above, was lit up with a fiery red glow, which changed slowly to

purple and then to blue. We were, however, not in darkness, for soon after the sun had set the moon rose and shone brightly, revealing everything with wonderful distinctness in the clear air. And still for half an hour that wonderful glow remained on the horizon of the Pacific, a great red line of subdued fire high in the air.

The next day we returned to Inca. It was then found necessary that all should take a rest after their hardships. Mr. Vines was suffering great pain from having his face much frost-bitten. So we crossed the Cumbre pass into Chile for a few days. On our return, the high camp on Aconcagua was again visited for the purpose of further observations.



SERACS HORCONES GLACIER, NORTH-WEST SLOPES OF ACONCAGUA, BACKGROUND TO RIGHT.

It was getting late in the season, and the weather interfered much with our work at the high camps on Aconcagua. I heard so much about Tupungato and the difficulties surrounding it, from the people of Mendoza, that I particularly wished to see it ascended. I took, therefore, the first opportunity the weather gave to send Mr. Vines to the south to attempt the mountain, while Lightbody and I confined ourselves to the traverse work in the high valleys leading to Aconcagua. Tupungato is a mountain about 22,000 feet in height on the great chain which forms the water-parting, and at the same time the frontier boundary, between Argentina and Chili. It is roughly in lat. 33° 20′ S. and long. 69° 45′ W., 50 miles east of Santiago, and 120 miles from the Pacific coast.

It was at Vacas that Mr. Vines made his head-quarters for the journey. Here it was possible to obtain fresh meat and bread. With Zurbriggen, Lanti, and a native arriero and three pack-mules, he started from Vacas on March 25. A somewhat late start was made, owing to the necessity of reshoeing most of the animals for the rough work before them. They followed the pass road for a mile to the south, to the junction of the Inca and Tupungato valleys, where they crossed the Rio Mendoza. The great main valley mounts up to Cuevas towards the Cumbre pass at a gradient of about 3 in 100. In the Tupungato valley the gradient is much smaller. Travelling was fairly fast at first, but afterwards the track became difficult to find amongst the great stone falls which filled the valley-side right to the edge of the river. This was most trying work for animals, and great care had to be taken, as only the best of the horses were able to cross without getting their legs stuck in deep holes between the great stones, and all came through badly cut about the legs. Up this valley Tupungato appeared as a great dome, almost entirely covered with snow, 30 miles away. Several hours over the *débris* brought them to a narrow gorge, and then the valley broadened out, forming a great plain more than a mile wide, which had formed the bed of a lake. Silting and denudation had filled it up, causing it to force a passage and drain itself. At sundown the party encamped, where there was good pasturage for animals. About 12 miles only had been made this day. The journey was continued from sunrise to sunset on the following day. Soon after starting, a magnificent view was obtained of the great ice-peak of Pollera, about 20 miles away on the frontier boundary.

So far, since the previous morning, the way had been comparatively easy. The main valley ran to the foot of Pollera, and on to a difficult pass over into Chili. The caravan, therefore, had to turn up a tributary valley running down from the south. It was impossible to negotiate this where it joined the main valley, for the rocks rose precipitously from both sides of the river-bed for several miles. A way had to be made direct up the mountain-side about 1500 feet above the river-bed. Here the going was both dangerous and difficult. Pack-mules had to be frequently unloaded where the inside rocks made it impossible for the panniers to pass. One mule fell 150 feet, and was given up for lost. A porter, however, was sent down to look for it and secure the harness. He found the animal, and managed to bring it up again, and it worked well for the rest of the day, lightly loaded, though badly cut about the head, sides, and legs. The valley widened out, and a descent was made to better ground. However, it took the same direction as the main valley, namely, towards the frontier to the south-west, and a second tributary valley had to be penetrated. The going was very slow, as the difficulties of transport continued throughout the day; at sunset only another 15 miles had been covered. While they were looking out for a suitable

camping-ground, a large dog fox was put up, and had not got 300 yards from the caravan when a fine guanaco hound, which the mule-driver had brought with him, was in full pursuit. An exciting chase followed up the steep mountain-side. The sport was too good to be lost; and, though the ground would have been voted impossible in any other country, and men and horses were thoroughly tired, the whole party were soon in full gallop down dry torrent beds and over broken ground. This reckless chase ended in a pitched battle between hound and fox, resulting in the death of the latter—a very fine specimen, which Zurbriggen skinned before turning in. The way offered no great difficulty on the third day, though the going was slow. The river had

THE PENETENTES.

cut down a deep channel in the middle of the valley, the old river-beds rising in terraces 30 to 40 feet high each side, perfectly flat, with growth of Yareta, or Andine thorn, and tufts of coarse grass. This Yareta was of very great use to us in the high valleys for firewood; for, though the branches are low and insignificant, and flare up and burn quickly, the roots are fairly substantial even at 11,000 or 12,000 feet.

Now the first near view of Tupungato was obtained. About 7 miles as the crow flies from the actual summit, the great dome was seen to rise from the valley, on the southern and eastern sides covered entirely with snow. On the north-western side was a great spur about 3000 feet lower

than the dome, running out for 4 or 5 miles from it, almost entirely clear of snow and ice, though there was snow and glacier 2000 feet lower at its northern base. The valley divided here, one branch continuing south, the other south-west for a mile, where it divided again, the two branches running south-west up to the rocks surrounding the great mass of Tupungato, and south-west by west to the frontier.

A great difficulty now presented itself. The valley became barren of vegetation, and inaccessible for further mule transport at 11,000 feet. It would be necessary to sleep a night on the mountain at a much greater height, and the porterage was very limited. A mule was, however, forced up to 13,000 feet, and Mr. Vines and Zurbriggen slept in the

TUPUNGATO, 30 MILES DISTANT. TAKEN WITH TELEPHOTO LENS.

open at 14,000 feet. The following morning an attempt was made to reach the summit. The party ascended the great spur at its lower end, and, traversing the whole length of it, reached a height of 19,000 feet. They were too exhausted to go quickly, though the gradient was slight, and it was late in the afternoon when a storm gathered round the summit, hiding it entirely from view, so that they could not find their way in the thick mist which gathered, and were forced to beat a hasty retreat. The next day all returned to Vacas for more provisions, mules, and porters. Throughout the return journey Mr. Vines took careful bearings of the valleys with the prismatic compass.

A fresh start was made from Vacas on April 3, with two more porters and extra transport accommodation. The pack-mules were got

off before daybreak, and by forced marches the camp in the valley at the foot of Tupungato was reached in two days. A second attempt was made from the old bivouac at 14,000 feet on April 6. Four started on this occasion. They found an easier route, avoiding as much as possible the tiresome rotten *débris*. On reaching the top of the great spur, they were overtaken by a terrible storm, and all suffered very acutely from the cold and the altitude. One man suffered from violent pains in the legs, which rendered his lower limbs useless, and he had to be sent back. Zurbriggen was very ill, and in great pain. They struggled to a place about 500 to 1000 feet higher than that reached on the first attempt.

TUPUNGATO VALLEY. THE MOUNTAIN IN THE DISTANCE.

Here they sheltered under a rock, hoping that the storm would blow over. On the contrary, it increased in violence, and the air became so thick with clouds that all thoughts of waiting longer had to be given up. The party returned to the base camp late at night, exhausted and disheartened. The great distance to be traversed, the effect of the altitude, and the shortness of the days made it impossible to ascend the mountain from so low a level at this time of the year. So, after a few days' rest at the base camp in the valley, a bivouac was made at the height of 17,000 feet, at the foot of the great spur. This time no attempt was made to ascend higher, for a tremendous wind-storm arose in the night, which completely wrecked the little tent, and Mr. Vines with two

guides were nearly frozen. They were sleeping on glacier, and the thermometer stood at 5° Fahr.

Again they retreated to the valley, and rested for a day, hoping for the weather to improve. On April 11, Mr. Vines, with Zurbriggen and a porter, slept at the same bivouac at 17,000 feet. An early start was made on the 12th, and, the weather being bright and clear, they calculated to reach the summit at about two in the afternoon. The summit proved to be much higher and further off than had been supposed, and it was not until four o'clock that Mr. Vines and Zurbriggen reached it. Fifty miles to the north-west Aconcagua stood up alone, like a huge rock out of a sea of lower mountains. There was nothing between to interrupt the view. Mr. Vines took several photographs of Aconcagua, both from the ridge and the summit of Tupungato. The great mass of Mercedario, one of the highest mountains in the Andes, could be clearly seen 40 miles to the north of Aconcagua. To the north-east the Cerro de la Plata stood up from a great mass of high mountains. Turning further from the north and looking due east, the Cerros became very low, and almost disappeared in the low hills sloping down to the pampas, not 15 miles east of Tupungato. The rivers winding through the great plain, and even the railways, could be clearly seen. The southern aspect could only be scanned from the summit. The volcano of San Jose de Maipu was the chief feature in this direction. The great frontier boundary-line, of which Tupungato and its great spur form part, the water-partings of the rivers to the Pacific and Atlantic, were very clearly marked to the north, 40 or 50 miles away beyond the Cumbre pass, and far to the south to Maipu.

Beyond the northern end of the great ridge lay a col covered with snow and ice, rising up to the beautiful ice-peak of Pollera, 19,000 feet in height; then another col, and the great pyramid of Navarro, some 500 feet higher; and beyond the great peaks and glaciers of Juncal, 1000 feet higher still. From Maipu the water-parting runs due north to Tupungato, and then the line of the great peaks turns to the north-west and west to the Cumbre pass, where the water-parting again runs north. While climbing up the ridge from the eastern side, and gradually nearing the top of it, the party noticed a strong, sulphurous, burning smell, and on arriving on the top of the ridge a volcano was seen about 20 miles to the south-west in great activity. The wind had blown from the west, bringing the smell towards Tupungato, but, as seen, it came from the north-west, and great volumes of smoke stretched away to the south. It had the appearance of a great ridge, about 13,000 feet in height, running towards the north, when its height gradually dwindled. A great fissure appeared in the middle of this ridge, from which the smoke poured forth in dark brown volumes. Nothing could be seen of this during the earlier attempts on the mountain, as the view to the west had been obscured by clouds. The coast-line could be seen clearly running for 100 miles to the north.

The breadth of the Cordilleras at this point was 60 miles only. They seem to narrow down at this latitude. The great plain in which Santiago is situated is not more than 45 miles to the west from Tupungato. Those 45 miles between Tupungato and Santiago are filled with range after range of high mountains. But from the top of Tupungato eastwards, a man can look almost down into the great plain of the pampas. North of here the Cordilleras widen out, until at the latitude of 32° 50′ they rise up from Mendoza and continue almost to the sea-coast, a distance of 150 miles.

During the climb up the great ridge, which runs at an angle of about 15° to the summit of the dome, many specimens of rounded stones, hollow or cup-shaped in the centre, were noticeable. These were probably volcanic bombs thrown from the ancient crater of Tupungato, and by the force with which they were thrown up, twisted into this peculiar shape, and hardened before falling. During the ascent the specimens were too large to carry, and the descent we made in the dark, so that there was no chance of collecting any of these stones. On the top of the dome of Tupungato is a great plateau, which stretches over an immense area, and there rises up from it three peaks, that on the far south of the dome being the highest, attaining to a height of 300 feet above the plateau. The whole of the north-western sides of the dome, as also the plateau, are comparatively free from snow, and yet on the eastern and south-eastern sides the mountain looks entirely white. In between two of the peaks on the plateau there lies a great quantity of black volcanic ash and scoria, of which some specimens were collected. The actual summit of Tupungato is a very interesting specimen of andesite, riddled by fulgurites, *i.e.* tubes melted out by lightning. A night was spent on the descent again at the 17,000-feet bivouac, and the valley was reached on the 13th. Mr. Vines and Zurbriggen determined, if possible, to start at daybreak on the next day, and try and reach Vacas before sunset. They selected the best of the animals, and started before daybreak on April 14, relying on their horses in the pitch dark to find the way for the first hour, and without drawing rein for fourteen hours, except to water their horses at noon, reached Vacas the same day, a distance of nearly 50 miles, over rough and dangerous country. The rest of the time was spent in survey work and measurements, to determine the height of Aconcagua. This we make out at present to be 23,080 feet, but we have not yet worked out all our calculations. Concerning this, Mr. Lightbody will presently give you a more detailed account.

We were driven out of the Horcones valley by a heavy storm on April 30. I forced my way up the valley some weeks later with Philip Gosse. The first night we camped in a terrible snowstorm. It snowed all night, and we considered ourselves lucky to be able to get down at all the next day. The winter snows having now come down

heavily, we were obliged to quit our work. Our horses and mules were dying from cold and exposure. It was, however, a long time before we were able to get our luggage, containing the results of our work, down to Mendoza, as the roads were all blocked with snow, and porterage very difficult to obtain.

During this time Philip Gosse fell ill, and for some time we were extremely anxious concerning him. At last, on June 19, Mr. Vines and I crossed the Cumbre pass in midwinter through heavy snow. Mr. Lightbody had preceded us a week before.

In conclusion, I must say that the success of our work was due entirely to the unfailing energy and co-operation of my colleagues, who, through the many difficulties and dangers of our work, preserved an unfailing cheerfulness, and were ever willing to surmount obstacles that at the time seemed well-nigh impossible. It was thus, that after six and a half months of labour, we brought our work in the High Andes of Argentina to a close.

Before the reading of the paper, the PRESIDENT said: It is scarcely two years since we welcomed Mr. Fitz Gerald here on the occasion of his return from the exploration of the southern Alps of New Zealand, when he described to us most adventurous journeys, having valuable results. He has, I think, surpassed himself in perseverance, and in the privations and hardships he has gone through in his recent expedition to the Andes of Argentina. We may look upon this meeting as a memorable one, for those who planned and carried out an expedition are present, the result of which has been the attainment of the greatest height that has ever been certainly reached by any human being.* I will now ask Mr. Fitz Gerald to read us his paper.

After the reading of the paper, the PRESIDENT said: I will now call upon one of the two gentlemen who have ascended the greatest height ever, with certainty, reached upon this Earth. I will ask Mr. Vines to say a few words.

Mr. S. M. VINES: When Mr. Fitz Gerald asked me to continue and finish the ascent of Aconcagua, I felt far more confidence in myself than in rising to speak before you to-night, and really there is little that I can add to the interesting paper which has just been read. I think, however, that Mr. Fitz Gerald has not really put before you the trouble which he took in preparing the way for reaching the summit of Aconcagua. Between our base camp at Inca, which he has told you about, which was situated at 9000 feet, and our camp at 18,700 feet on the slopes of the mountain, from which the final climb was made, we had three distinct camps: at 12,000 feet, and at 14,000 feet, and at 17,000 feet. By amply provisioning these camps, and by the assistance of porterage, we made it possible for the expedition to accustom themselves to the altitudes, and so made the ascent of the mountain feasible. It was very necessary, indeed, to accustom ourselves to the altitudes. There was a certain malady which we all

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* Mr. Johnson, the Indian surveyor, was supposed to have reached 23,870 feet, but this is extremely doubtful. Mr. Graham and Emil Boss ascended a peak, which they supposed to be Mount Kabru (24,015 feet), in Sikkim in 1883; but the identity of the peak has aroused a conflict of opinion, and must remain uncertain. About the ascent and height of Aconcagua there is no doubt.

suffered from in the expedition; it is called mountain sickness, but I will call it by a shorter name to-night. The people dwelling in the Andes of Chili and of Argentina call it puna, and I think it is a very good and short word for expressing the malady.

I wish to say that I endorse everything Mr. Fitz Gerald has said on the subject of puna, and I will just add a few words to the very interesting information that has been given to the world by Sir Martin Conway and Mr. Whymper. Since descending from the mountains, we have been frequently asked if we suffered from those terrible bleedings from the nose and mouth and ears, which are always experienced by people who go up to high altitudes. Now, I do not know whether the Fitz Gerald expedition was particularly free from apoplectic tendencies, but certain it was that none of us ever suffered in this way. Perhaps it was due to our mode of training, and the splendid commissariat that was arranged for by Mr. Fitz Gerald. I myself used to train on the heights around Inca, with a watch in one pocket and an aneroid in the other. But no amount of mountain training will help one at certain altitudes from this malady of puna. This is well shown by the fact that, on more than one occasion, as soon as we descended from our camp at 19,000 feet into the valley we became different men. Once Mr. Fitz Gerald and I set out from our high-level camp feeling very ill. We reached the 14,000-feet camp in the valley, and flung ourselves down in the tent utterly exhausted. We were unable to eat. Our one desire was to rest. After resting an hour our appetites returned, and an hour later I proposed to Mr. Fitz Gerald that we should walk down to Inca. He consented. The distance was 20 miles over the very roughest country, and we covered the ground in something less than five hours—clear evidence of the benefit derived from descending to lower altitudes. The effects of puna were very various. We found it affect us with intense headache at night-time. I had a terrible headache the first night I arrived at the 19,000-feet camp; and suffered from very severe pains in the lower limbs, such as I should describe as a sort of "growing pain." We also experienced extreme breathlessness and entire incapacity for doing any work. I remember, the first morning after my arrival at this high camp, Mr. Fitz Gerald set to work to do the cooking, which consisted of making some coffee; we did not want anything more. He told me to go and get the water for the coffee; this consisted of taking a biscuit-tin and filling it with snow and ice. The snow and ice were exactly 10 yards distant from where I stood, near the fire. The guy-ropes of the tent stood in my way. I stepped over one of them with one foot and waited, and then I dragged the other leg after the first, and so on, until I reached the spot. I was ten minutes gone, and when I got back I had just enough snow and ice to wet the bottom of the kettle!

Then again as to how we made the ascent. Some of the papers describe my ascent of Aconcagua as being done on all fours. Now, although I frequently tumbled on to all fours, I did not crawl up like a monkey, as the paragraph seemed to imply. We were always troubled with breathlessness and weariness, and had to rest frequently, so that near the summit of Aconcagua it came to resting every 5 yards, not in height, but in distance. I found that it was useless to sit or lie down to rest. Exhaustion prompted one to throw one's self down flat, but the achings in one's limbs after resting in that way were so severe, that we found it necessary to lean forward on our ice-axes without sitting down at all.

In conclusion, I would like to say that it was only owing to the great forethought of Mr. Fitz Gerald and his fine knowledge of equipment, his carefulness in detail, which did away to a great extent with the hardships—although not entirely, of course—and still more his great unselfishness and generosity in doing all

things in his power for the success of those working with him where he himself had failed, that made the ascent of the mountain possible.

The CHAIRMAN: I now call on Mr. Lightbody, who has, I believe, conducted the work of ascertaining the height of Aconcagua.

Mr. LIGHTBODY: As regards the survey work of this expedition, I was fortunate in having a chief who is thoroughly alive to the necessity of being well equipped with good instruments, and is himself a very skilful observer. We used two 6-inch transits, a 5-inch, and a smaller 3-inch theodolite, also a sextant, besides many other instruments for determining height by hypsometrical and barometrical results. In measuring the height of Aconcagua, the sextant and 6-inch instruments only were used. You are all aware, no doubt, that for the construction of a railway most careful levels are taken from point to point over the company's property. These were brought from low-water level at Buenos Aires on the Atlantic, and taken right over from one railway to another, until we arrived at Punta de las Vacas. We took a series of levels in the ordinary manner with a 16-inch engineer's level up to a station on our triangulation near to our base camp, whence we had a good view of Aconcagua. From this point we surveyed, making a traverse on what is called the bar-subtense system, and we arrived still further up the Horcones valley close to the foot of Aconcagua. It was here that we made our final observations for ascertaining the height of Aconcagua. So, you see, it was a perfect method of procedure, beginning from the sea-level and avoiding any hypsometrical or barometrical results, which are never quite reliable; they are always more or less approximate. I may mention that the bar-subtense method was recommended to us by Mr. Coles as being the most reliable we could employ in a country so rough. At our various stations along the traverse we took observations on to the summit of Aconcagua, so that we could check one with the other, and ascertain as accurately as possible what the real height was. The mountain has been previously estimated at heights varying from 22,421 feet to as much as 25,000 by such well-known men as Admiral Fitzroy, who went out in the *Beagle* many years ago; also Pissis, whose map is well known; Stelzner and Güssfeldt, who made such a desperate attempt to get to the summit of Aconcagua, and others. There were many difficulties from the strong winds and the accompanying clouds of cutting dust in doing instrumental work; but Mr. Fitzgerald always insisted in verifying work done under these conditions. Owing to the large number of calculations that we have to go through, we have been unable to give to-night our definite height on the hand-map. There may be some slight variations, because a great deal of work has to be done in going through these calculations. We have many note-books full of them, and our work, I may say, has been somewhat interrupted by illness since our return to England. I will conclude these remarks by expressing my feelings of gratitude in having the good fortune to work with such a man as Mr. Fitz Gerald. In times of adversity or of difficulties, his pluck and perseverance were ever to the fore, and the rigid methods he employed in working out all calculations—very monotonous work up there, working out calculations in a wretched camp—and the pains he took to obtain accuracy, will always be a subject of admiration.

The PRESIDENT: I will now call upon Mr. Philip Gosse, who conducted the work connected with the natural history of this expedition. Mr. Philip Gosse has the very great advantage of having a father present who is well known to Englishmen for his great literary attainments. Mr. Gosse has kindly undertaken to speak for his son, who feels the diffidence of youth, and to tell us the results of the young naturalist's researches.

Mr. EDMUND GOSSE: In kindly calling upon my son, Philip Gosse, you are in

the position of the sovereign in Prior's poem, who found that "when he called another, Abra came." My intrusion will, I hope, be excused, since my son is positively too unused to public speaking to face so formidable an assembly as he sees before him. You will have already gathered from the photographs which have been exhibited, that this grim valley of the Andes was likely to be extremely disappointing to a naturalist. It had none of the luxuriance of a tropical country. You have heard, in Mr. Fitz Gerald's fascinating narrative, of a barren land where sand-storms blow all day over a desert of loose shale. There was, in fact, hardly any apparent animal or vegetable life at all. In one of the very entertaining letters which Mr. Fitz Gerald wrote to Mr. Norman, he said that, so far as he could see, there was nothing alive in the neighbourhood, and, since my son arrived in camp every evening with beasts, and birds, and bugs, he could only conclude that he must have brought them over in bottles from England. In spite, however, of this aspect of extreme sterility, life exists even at that height, and it impresses the imagination to realize that a large number of specimens were brought from the upper camp of more than 14,000 feet—that is to say, from an altitude greater than that of the summit of the Aletschhorn.

Mammalia were extremely few. The one animal of importance is the huanaco, or wild llama, a graceful timid creature with no power of protecting itself except by its fleetness. The puma is supposed to be unknown at this elevation, at least so far south; but although the Fitz Gerald expedition did not see a specimen, they had reason to believe, from the reports of the natives, that pumas were seen occasionally in the Horcones valley. My son found a vole (*Phyllotis griseo-flavus*), not infrequent at this height, and a specimen which he has deposited in the zoological gardens is the only one which has ever been brought alive to England. Of birds his collections were more abundant, and here he has enjoyed the inestimable advantage of having his specimens named for him, with extreme kindness, by one of the greatest of living ornithologists, Mr. P. L. Sclater, the secretary of the Zoological Society. The points of scientific interest about the birds he found are chiefly these. A great many of the species which he brought home are now first added to the Argentine fauna, having hitherto been believed only to be Chilian. Another important matter was that no specimens of a great many of these species were to be found in any museum brought from anything like so great a height. A very curious point about these is, that they present very much more uniform and more sombre appearance than the specimens of the same species that have hitherto been described. Another matter of some importance was my son's observation of the habits of the animals. Very few people have ever had the opportunity of observing living creatures of any kind at so great a height. As an example, I may mention the family of the *cinclodes*, which are little birds very much like our own water-dippers; of these he brought back several species, all known to science, but hitherto unobserved in life. He has made copious notes of the habits of those birds, their modes of nesting, and various facts of that kind. The principal bird, of course, at those great heights, is a gentleman who awaits us in the next room, and whom I regret not to see on the platform, a condor 10 feet from wing-tip to wing-tip. The condors seem to be the only living things in that desolate valley, floating round the tops of the mountains with a lazy flight, but, the moment anything attracts them, sweeping down with a whirring noise and a pressing curiosity very sinister and intimidating. I am warned to avoid details, but one anecdote of those austere valleys I must tell you. One morning my son, who had been sleeping in the open, woke up and felt something sitting on the brim of his hat; it was a humming-bird, a brilliant little creature, brown, with a dazzling emerald-green breast-plate. As he stirred, it suddenly flew off;

but he remained perfectly still, and the little creature returned and again perched on his hat, preening itself there until it presently flew away again, and after hovering about a little while disappeared.

Of insects he found exceedingly few; it seems as if the extreme height is distressing to them. There are even no parasites on the animals. The mules lost all their fleas, and, what was more extraordinary still, the condors and other birds had none of their customary parasites. Tarantulas there were, and a boisterous fly that made a clicking noise by day and night. Several new scorpions have been brought home, not yet named, but believed to be unknown to science. Some interesting beetles and wasp-like flies have been lost to science through what I can only call an outrage. My son collected these insects, and, finding that there was no methylated spirit left, helped himself to a bottle of whisky and put them in that, while he went out to make fresh captures. I can hardly bear to tell you what occurred next; but it is necessary that this painful incident should be unveiled to you. The remainder of the expedition came in while my son was out of camp, and in the dusk they helped themselves to this bottle of whisky; they drank its entire contents, and those invaluable specimens are lost to science for ever.

I must now, for a moment, speak of the plants. Miserable and barren as the place seemed, my son was able to bring back between sixty and seventy species. These have been named by Mr. Burkill, of Kew. There are no trees in the Horcones valley, nothing larger than a coarse prickly shrub. A few flowers grow in summer by the banks of the streams. The only touch of colour in the landscape is given by large tracts covered, in their season, with nasturtiums of every degree of shade and tone, from palest yellow to deep hues of orange and bronze. Some of the plants he brought back have been hitherto only known by very imperfect and confused specimens; for example, the interesting genus of *Senecio*, which Sir William Hooker arranged in 1841, will be re-arranged and re-described from the specimens of many species brought home by this expedition; some interesting algæ, too, were brought from the high ponds. This is a slight outline of what my son, himself an absolute novice, on his first occasion of zoological and botanical travel, has been able to bring back. I cannot sit down without asking your permission to express, in this public way, my warm sense of indebtedness to my friend Mr. Fitz Gerald for his kindness, the more than fraternal care which he took of my son, and for the faith with which he accepted so young a naturalist on the strength of his first enthusiasm. It is impossible for me to overestimate the extreme kindness with which Mr. Fitz Gerald encouraged my son, and guarded him through all the adventures and dangers that you have heard of.

The PRESIDENT: That portion of the mountain of Aconcagua which is in this country has been entrusted to Prof. Bonney, and he has kindly promised to address a few words to us on the subject this evening.

Prof. BONNEY: You might suppose that expeditions of this kind could not add very considerably to our geological collections; nevertheless, Mr. FitzGerald and Mr. Vines have brought back about thirty specimens from Aconcagua and Tupungato. From Aconcagua, the lowest rock they have brought was a reddish limestone, with some impressions of ammonites, showing that these belong to the sedimentary rocks which make the foundation stones of the Andes. After that they obtained some gypsum in a valley under the mountain, and then passed in the ascent over a series of volcanic rocks. It is not necessary for me to go into details, but I will merely say that one very remarkable piece of rock was picked up at a height of 21,800 feet. All the rest of the rock, so far as the specimens show, is very much of the same character. This, however, Mr. Vines says, was quite different from

that in the neighbourhood. It is a small piece of dark rock, which under the microscope proves to be wholly crystalline, and consists mainly of hornblende. That rock must have been ejected from some very great depth in the Earth; it has nothing to do with the lava and scoria of which a volcano is formed. The actual summit of Aconcagua is hornblende-andesite. On Tupungato they found at the 11,000-feet camp a rock which has a higher percentage of silica than the aforenamed. After that they got very nearly the same rocks on Tupungato as they did upon Aconcagua, only on it there was a larger amount of volcanic scoria. The summit rock is perfectly riddled by fulgurites—those curious tubes lined with glass and made by lightning. Two points are of general interest: the first, that in all the upper parts of these two mountains, 50 miles apart, almost identical rocks occur; and, more than that, these rocks bear a very strong likeness to those brought back by Mr. Whymper from the equatorial Andes. The second point is this, that, while both these great peaks are volcanic, the craters have wholly disappeared. From Aconcagua itself no scoriaceous specimens were brought back, and this fact, combined with the enormous precipices on the eastern side, would lead me to suppose that beds of lava enter very largely into the composition of that peak. The present summit is either a dyke in the wall of the old crater, or else the actual lava-plug which has choked up the bottom of it. Consequently the whole of the crater has gone, and that which was the lowest part is now the highest. So that we may fairly assume that one or more thousand feet once rose above the present top of Aconcagua. The crater has also gone from Tupungato, but on its top there is very much more scoria; so that probably more ruins of it are left here than on Aconcagua itself. The rocks from other peaks I have not yet had time to examine; and, in speaking, I have strictly confined myself to business, for if I were to begin to express my admiration of the pluck and perseverance shown in these ascents, I should keep you here, I am afraid, till rather a late hour.

The Chairman: Perhaps Mr. Douglas Freshfield will say a few words to us.

Mr. Freshfield: I had no intention of addressing the meeting this evening, but your commands here are always law, and I should be very sorry to appear in the least degree backward in tendering my congratulations to Mr. Fitz Gerald and his companions, particularly to Mr. Vines, who, with very little mountaineering experience beforehand, succeeded in getting to the height he attained, which is certainly one of the greatest heights that has ever been reached. It is a curious coincidence, and I cannot help noticing it, that while we are here to-night to listen to the story of the first ascent of the highest point on the American continent, some of us will meet to-morrow night at the Alpine Club to celebrate the first ascent of the mountain that has until lately (when it has had to yield to its neighbour, Mount Logan) been considered the highest in North America—Mount St. Elias. To-morrow Dr. Filippi will give his description of the ascent of that great mountain by an expedition led by H.R.H. the Duke of the Abruzzi, the nephew of the King of Italy. Last year was a singularly notable one in the exploration of mountains in America. At the time your delegates were being fêted on the Canadian Pacific railway, some of the members of the Alpine Club, a few miles further north, were discovering unknown glaciers and verifying the existence of the great mountains, Mount Brown and Mount Hooker, which were first seen by Canadian surveyors years ago, but whose altitude had been called in question. When a feat has once been accomplished, it is apt to become comparatively easy. But we must remember that in both these cases of Mount St. Elias and Aconcagua there had been attempts which were not successful. Dr. Güssfeldt was an accomplished mountaineer, and yet he failed on Aconcagua, and we must regret his absence to-night when he would have been the first to tender his

congratulations to the English expedition which was able to carry to completion the task he left unfinished.

I might be drawn by Mr. Fitz Gerald's paper into the discussion of other topics. The effects of low pressures, of the "rarity of the air" on the human frame, the greatest heights respectively reached by various climbers on mountains—these are more or less open questions, which it would take some time to discuss satisfactorily. But they are, I think, more suitable for discussion before a body such as the Alpine Club than before a Society whose aims are more general, and which has not on its Council at the present moment any one qualified to express an expert opinion. I will therefore conclude by repeating what I am sure is the feeling of every one here, and more especially of all mountain travellers, who know how much care and forethought are needful to organize such an expedition, as well as how much endurance in the actual work of climbing, that our best thanks are due for what has been done by Mr. Fitz Gerald and his companions in conquering Aconcagua, and bringing home so complete and vivid a description of the district in which it is situated.*

Sir MARTIN CONWAY: At this late hour I will content myself with taking the opportunity that you have been good enough to give me to congratulate Mr. Fitz Gerald and every member of his party on the admirable results attained by their most important and interesting expedition. There are many points that would be interesting to discuss if there were time to discuss them. Particularly interesting is Mr. Vines' account of the effects of high altitude upon the human frame as observed in the different members of that expedition. In the main they are similar to, almost exactly the same as, those that I and the members of my expedition experienced in the Himalayas at corresponding altitudes. I think that every expedition that goes out to high mountains—mountains above 20,000 feet—and comes back again, brings, or has brought, with one single exception, accounts of exactly the same kind of experiences that the members of this expedition have recorded at high levels. There is a single exception, and one only so far as I know, that of the Himalayan expedition of Mr. Graham. His observations are at variance in all respects with the observations of all other mountaineers whatever. That is an important matter, too long to go into to-night; but when talking of high ascents, it has to be borne in mind, because Mr. Graham claimed to have climbed to an altitude of about 23,700 feet, which would undoubtedly be the highest ascent ever made. All mountaineers have that ascent in their minds when they discuss this question of the highest level that has been reached by climbers. At all events, whether that ascent was actually made or not—and I for one do not believe that an ascent to that altitude was made at the time and in the place in question—but whether it was made or not, we have Mr. Fitz Gerald and Mr. Vines here safely returned from some ascents of a very big and interesting kind. There is one point in connection with these ascents which I perhaps am peculiarly able to appreciate and emphasize. Aconcagua is about 23,080 feet high. My own ascent was of a mountain which was barometrically measured at 22,600 feet, and trigonometrically measured at 23,000 feet. At all events it was within 200 or 300 feet of Aconcagua. Now, our experiences were similar to Mr. Fitz Gerald's and Mr. Vines' in many respects, but we did not have to face the howling gales which raged about Aconcagua. Mr. Fitz Gerald and his party were really quite exceptionally tried, I conceive, by the violent gales of wind they had to face daily. If there had been no movement in the air whatever, they would have been tried in

* Mr. D. Freshfield desires to refer those interested in the questions alluded to in his remarks to an article contributed by him to the number of the *Alpine Journal* for February, 1898, No. 139, "The Highest Climbs on Record."

another way, for few things are more painful than absolutely still air at great heights, as Mr. Vines noticed in the sheltered couloir on Aconcagua. But between a gently moving breeze, which is what you want, and these raging gales, which blow men and animals down flat, there is considerable difference. When you remember that the ascents we have just heard described were made in that kind of weather, I think you must look upon Mr. Fitz Gerald and his party as having acquitted themselves right well. I am sure I congratulate them with all my heart on the success they have attained.

The PRESIDENT: I should be sorry to say how many years ago it is since I first made the acquaintance of Aconcagua. I used to gaze upon it for many days, both from Valparaiso and from heights above Quillota. I can only claim a slight bowing acquaintance with that great peak, and I never attained to that intimacy which it has been the destiny of Mr. Fitz Gerald and his companions to acquire. I congratulate them on the excellence of their topographical work in connection with Aconcagua and the other mountains near it, and I think, when we contemplated and listened with interest to the work that has been done by them, we should have remembered that this is only a very small part of the unknown region of the Andes. Hundreds and hundreds of miles of these mountains are unknown. It is too soon yet to say whether Aconcagua is the highest peak in the Andes, for many lofty peaks, said to be over 20,000 feet in height, have never been measured; they have never been visited, have never been approached by any one who was capable of describing them. Special interest attaches to the exploration of these Andean ranges, because they all have associations connected with them—legends and stories from the time of the Incas, or from that of the Spaniards. For a particular purpose, I will allude to one memorable incident which happened within sight of Aconcagua. There a march was made, a military achievement was performed far superior to that of the passage of the Great St. Bernard by Napoleon, and comparable with the passage of Hannibal over the Alps. In 1817 General San Martin, in order to achieve the liberation of Chile, crossed the pass of Los Patos within sight of Aconcagua. He had to think of many things. First the grand conception of doing it at all, then all the details connected with the commissariat had to be provided for. He took five thousand men, with artillery, materials for making bridges, and provisions, safely across that pass, fought the battle of Chacabuco within three days afterwards, and entered the capital of Chile within five days. Now, that was a great achievement. He did not forget anything. He did not forget that sickness which has been alluded to by Mr. Freshfield and Sir Martin Conway; he provided for that also. The natives now, I know, call it puna, but the name of the disease is *sarochi*. I have been in the Andes up to 17,000 feet, and often to 12,000 feet and 16,000 feet, and I never suffered from it myself except on one occasion, but my mules did, and I used San Martin's remedy, which did them a great deal of good. I do not know whether the way San Martin and his people cured their mules was also applicable to the soldiers and the camp-followers. It was by rubbing their noses with garlic or onions, and the general took several mule-loads of garlic with him. I have alluded to this great achievement of San Martin because I consider that the work of Mr. Fitz Gerald is comparable to it. For a great explorer must have all the qualities of a great general. Like General San Martin, Mr. Fitz Gerald had first to conceive his great enterprise, then he had to consider all the details connected with it, then he had to select his companions and to train them; and if he was to succeed, as he has succeeded, he had to show those higher qualities of sympathy, of care for their welfare and comfort, which he has shown, and which have been testified to by his companions to-night. He also had to show that extraordinary pluck and indomitable perseverance in the face of the most miserable

life that could possibly be imagined, which enabled him to get through the work and to accomplish all that he has done. I am quite sure that this meeting will pass a vote of thanks to him by acclamation, and I hope you will join with the name of Mr. Fitz Gerald those of his companions—Mr. Vines, Mr. Lightbody, and Mr. Gosse.

THE GERMAN DEEP-SEA EXPEDITION.

Last year Prof. Chun, of Leipzig, laid before the "Gesellschaft deutscher Naturforscher und Aerzte" (corresponding to the British Association for the Advancement of Science) a plan for a German scientific deep-sea expedition. The proposal was well received, and a resolution approving of the plan, and recommending it to the favourable consideration of the Government, was unanimously adopted on September 24, 1897. As originally conceived, the expedition was intended to be exclusively zoological, after the manner of the Plankton Expedition, but Prof. Ratzel, of Leipzig, suggested that chemical and physical observations should be included in the work of any such deep-sea expedition as Prof. Chun had in view—a suggestion which has been acted upon. The German Government favoured the proposal, and during last winter the Parliament voted a sum of 300,000 marks towards the cost of the expedition; additional grants will be made to cover the expenses of the expedition and the expense of publishing the scientific results.

The vessel chartered for the purposes of the expedition is the steamship *Valdivia*, belonging to the Hamburg-American Line of steamers, of 2600 tons, 320 feet in length, 43 feet in width, and of 1250 horse-power. The directors of the Hamburg-American Company have entered into a contract with the Secretary of State for the Interior, with no desire to make a profit out of the transaction, but rather with a desire to encourage scientific investigation. This contract provides for the use of the ship and ship's company, provisioning of the members of the scientific staff (wine to be supplied at cost price), erection of a deck-house for microscopic work (to be fitted up in accordance with the wishes of the leader of the expedition), fitting up of a room between decks as a chemical laboratory lighted from the roof and supplied with electric light, fitting up of a dark room for photographic work, fitting up of other apparatus and machinery, and generally to fit the ship for the special objects in view, all for a slump sum of 340,000 marks.

The German Deep-Sea Expedition of 1898 has started under the most favourable auspices as regards the vessel itself, the arrangements made to adapt it for carrying on deep-sea investigations, and for the accommodation of the members of the scientific staff, and the apparatus and appliances to be used in carrying on the work, which are of the latest and most approved description. The *Valdivia* is about the same size as H.M.S. *Challenger*; she steams 10 to 11 knots; the bacteriological,

chemical, and biological laboratories and workrooms are commodious and well fitted up; the cabins occupied by the scientific staff are large and handsome, the principal cabin containing a splendid scientific library, including a complete set of the '*Challenger* Reports;' and there is ample accommodation for storing the marine and other collections made throughout the cruise.

The *Valdivia* sails under the command of Captain Adalbert Krech, who has been a whaling captain, and has been in the Rumanian-Turkish Services. In 1874 he saved at sea the crew of the American ship *Mary E. Emsten*, and received a gold medal from the Emperor, a gold cup from President Cleveland, and decorations from the Kings of Saxony and Rumania and the Sultan. Since 1882 he has been in the service of the Hamburg-American Line. Captain Krech has with him on board the *Valdivia* eight officers and engineers, most of whom have previously served under him, and a crew of thirty-five men.

Prof. Carl Chun, professor of zoology in the University of Leipzig, the originator and leader of the expedition, is accompanied by a staff of eleven scientific men, to assist him in carrying on the various observations, as shown in the following complete list of the members of the expedition:—

A. *Official members*—

Prof. Carl Chun, leader.
Prof. W. Schimper (Bonn), botanist.
Dr. Karl Apstein (Kiel), zoologist.
Dr. Ernst Vanhöffen (Kiel), zoologist.
Dr. Fritz Braem (Breslau), zoologist.
Dr. Gerhard Schott (Hamburg Seewarte), oceanographer.
Dr. Paul F. Schmidt (Leipzig), chemist.
Officer Sachse (Hamburg-American Line), navigator.
Dr. M. Bachmann (Breslau), physician and bacteriologist.

B. *Non-official members*—

Dr. August Brauer (Marburg), zoologist.
Dr. Otto L. zur Strassen (Leipzig), zoologist.
Herr Fr. Winter (Frankfort a/M.), scientific draughtsman and photographer.

Each member of the scientific staff receives eight marks per day from the Government, and their lives are insured for 30,000 marks each in case of death.

The *Valdivia* sailed from Hamburg on August 1st last, and is expected to be absent about nine months. The route to be followed may be divided into three portions: (1) From Hamburg round the north of Scotland to the Canary islands, past the Cape Verde islands, touching at the mouths of the Kameruns and Congo rivers and Walfisch bay, to Cape Town; (2) from the Cape of Good Hope, the Agulhas bank will be examined, then southwards past Prince Edward island to the edge of

the antarctic ice, returning northwards through the centre of the Indian Ocean to the Cocos and Christmas islands, and thence to Padang in Sumatra; (3) from Padang to Ceylon, thence calling at the Chagos, Seychelles, and Amirante groups of islands to Zanzibar, returning home by way of Sokotra, the Red sea, Suez canal, and the Mediterranean.

The expedition was accompanied from Hamburg to Cuxhaven by Staats-Sekretär von Posadowsky; the Burgomaster of Hamburg; the directors of the Hamburg-American Line; Prof. Neumayer, director of the Deutsche Seewarte; and many other scientific men; complimentary speeches, with good wishes for the success of the expedition, being delivered by the Home Secretary, the chairman of the directors of the Hamburg-American Line, and others. Leaving Cuxhaven at 8 p.m. on the evening of August 1st, the ship crossed the North sea to the Firth of Forth, preliminary trials with the dredging and other appliances being made on the way with signal success.

The *Valdivia* anchored off Granton on the evening of the 3rd, with the object of receiving on board additional scientific apparatus, and of landing Dr. Erich von Drygalski (who has been nominated to act as scientific leader of the German Antarctic Expedition of 1900), Dr. Georg Pfeffer (keeper of the zoological department of the Hamburg Museum), and Sir John Murray of the *Challenger*, who had accompanied the expedition from Hamburg. On August 4th, all the members of the expedition visited the *Challenger* Office in Edinburgh, and examined the specimens of deep-sea deposits, etc., brought home by the *Challenger*. In the evening, after being entertained to dinner by Sir John Murray, the expedition sailed for the Faroe channel and the Canary islands, being accompanied as far as the latter place by Geheimrath Dr. Mikulicz, professor of surgery in Breslau.

Preliminary accounts of the first dredgings, trawlings, and temperature observations in the North Atlantic have been received, the expedition having safely arrived at the Cape Verde islands. The expedition is now engaged in explorations off the west coast of Africa, and is expected to arrive in Cape Town in November.

DR. THORODDSEN'S EXPLORATION IN ICELAND, 1898.

Dr. Thoroddsen has sent us the following statement with reference to his work in Iceland during the past summer:—

"This summer (1898) I have finished my geographical and geological researches in Iceland, which were commenced in 1881, and I have succeeded in examining the whole country. This summer I investigated the interior highland north-west of Langjökull and the mountain region behind the valleys of Borgarfjord. The weather was rough and cold, with much rain; but as fogs were rare, the researches could be carried on without

serious hindrance. The large lava-field Hallmundarhraun, which hitherto has been but slightly known, was first examined; it was found to proceed from a series of craters bordering Langjökull. The north-western margin of the rocks of Langjökull is split by long crevices, and has terrace-like slopes. In one of these crevices we see the range of craters, but out of other fissures, older streams of lava have been ejected before the terrace-forming subsidences took place. The lava is very uneven, containing many fissures and cavities. Eiriksjökull and the Langjökull snowfields, like other snowfields in inner Iceland, rest upon large breccia tablelands which rise above the principal highland. These fragments of tableland, we suppose, were originally connected, forming a 3000-feet-thick layer of breccia, which covered the whole surface of inner Iceland, and which subsequently was cut asunder by erosion and carried away, leaving behind detached remnants. The strata underlying the breccia is everywhere tertiary basalt. Five very steep glaciers with large moraines descend from Eiriksjökull; three of them were hitherto unknown. On the western side of Langjökull nine new glaciers were found, two of which are very large. The highland north-west of Langjökull (Storisandur and Arnarvatnsheids) consists of mighty pre-glacial lava-currents, with distinct scratchings and a number of large erratic blocks on the surface. On the plateaux more to the west (Tvidogra) the firm rock seldom projects. Here we find an abundance of mighty moraines; the depressions contain bogs, with innumerable large and small lakes, most of which are shallow. The map is defective in this place, so that considerable measurements had to be taken in order to determine the relative situation of this multitude of lakes. On Tvidogra the tableland is comparatively low, about 1500 feet above sea-level. The vegetation is copious, and serves as pasture for large herds of sheep from the settlements of the northern and the southern country; the lakes are full of trout, and the bird-fauna is very rich.

"After having sojourned a considerable time on these high tablelands, examining their physical geography and geology, I went, in the beginning of August, to the mountain regions behind the valleys of the Borgarfjord. Here we erected our tents in different places 2000–3000 feet above the sea, made pretty long excursions, and climbed several rocks. The glaciers of the south-western angle of Langjökull were investigated, as well as older and more recent glacial formations. The weather as a rule was cold, in the afternoon seldom more than 37° to 40° Fahr. inside the tent, and 34° to 36° outside, with frequent frost at night. The pre-glacial volcano Ok, 3800 feet high, was examined. Hitherto it was thought that the pre-glacial lava-streams extending down to Begkjanes and to the neighbourhood of Begkjavik, proceeded from this mountain; but this summer's investigation proved that the pre-glacial lava about Begkjavik comes from a place of eruption on Mosfellsheidi, and not from Ok. The latter mountain, however, had also ejected much lava before

the ice-period, and lava-currents have flowed thence through the valleys down to the low country; such a pre-glacial stream appears distinctly, *e.g.*, in Flókadalur. The valleys here prove to be of much more ancient date than the ice-period. The mountains behind the Borgarfjord consist at the bottom of basalt, but in their upper parts of tufa and breccia. Hereabouts are several interesting deep lakes, as, for example, Beydarvatn and Hvalvatn, which seem to have been formed by glaciers during the ice-period. The lake-basins seem to be tertiary; afterwards the cavities may have been filled up with tufa and breccia, and these rocky substances eroded and carried away by the glaciers.

"At the end of my journey I made several excursions to volcanoes on the Begkjanes peninsula, in order to examine various volcanic crevices and craters."

PEARY'S 'NORTHWARD OVER THE GREAT ICE.'*

Lieut. Peary has personally presented to the Society a concise account of his arctic work, which is published in the *Journal*, vol. xi. p. 213. There could be no better epitome than that paper of the work now published in two handsome volumes very rich in illustrations—not less than eight hundred photographs—but only poorly supplied with maps. No doubt a new map of Smith sound is being prepared, for Mr. Peary, with his opportunities of sledging and boat-journeys along the coast, has been able to make very considerable corrections on the existing charts. The book is avowedly popular; the results of the very laborious scientific observations of many kinds, which were constantly made, have still to be worked up by specialists, and will appear as separate monographs. Still, the meteorological data are published in some detail, and there is also a fair account of the ethnology of the Smith sound tribe, with a complete census of all the inhabitants by name.

The illustrative photographs are very interesting, especially those of the people, which are unique. During the long darkness of the winter night, a great deal of work was done in photographing types of the natives by flash-light, and these pictures show a surprising development of physique. Much of the interest of the book necessarily lies in the description of the people and their ways. The account of their house-building is particularly instructive. The clean-cut, symmetrical beehives of transparent ice with which one associates the

* 'Northward over the Great Ice: a narrative of life and work along the shores and upon the interior ice-cap of Northern Greenland in the years 1886 and 1891–97, with a description of the little tribe of Smith Sound Eskimos, the most northerly human beings in the world, and an account of the discovery and bringing home of the "Saviksue," or great Cape York meteorites.' By Robert E. Peary, Civil Engineer U.S.N. In two volumes. London: Methuen & Co. 1898.

Eskimo do not appear to be erected by these people, who live in *tupiks* (tents or huts of skin) in summer, and in *igloos*, partly excavated, partly stone-built dwellings, in winter. The winter igloos seem to be appropriated by any family which fancies them for the time, and are not private property. There are some interesting reproductions of native drawings, showing considerable skill, and a couple of native maps of the coast-line, drawn offhand to show the position and succession of the capes and bays.

Although Mr. Peary, in his anxiety to avoid the introduction of "padding," says very little indeed of the work of previous arctic travellers, and expressly excludes "the stock chapter on equipment," he lets drop many valuable hints on the latter subject. He is a believer in furs as the only practicable material for arctic clothing, and only tolerates woollen underclothing. With proper furs, he never felt cold even with the thermometer at $-60°$ Fahr., and a strong wind blowing. He slept in the open air, and without a sleeping-bag latterly, content ing himself with the erection of a snow wall to keep off the wind.

The introduction contains a full account of the way in which the expenses of the various expeditions were met. It is not too much to say that the whole of the money was raised by the individual efforts of Mr. and Mrs. Peary, by their books, lectures, the conveyance of independent scientific parties in their chartered ships, and by inducing a few societies and a few individuals to contribute small sums. There was no government assistance or encouragement. Each year it was harder for Lieut. Peary to extort an extension of leave from the Navy department. For determined and persevering effort in the face of difficulties and disappointments, this series of explorations has had few equals. The story of the whole work is admirably told, with a wonderful command of language and descriptive force, but always in a modest way, making the least of trouble and danger and the most of the help rendered by companions and natives alike.

In the arrangement of the book, the excellent plan is followed of supplementing the narrative of each expedition by a note of the objects with which it was undertaken, and a summary of the results obtained; so that the essential facts are not lost in the multiplicity of details which makes up the narrative.

The introduction concludes with some words on the utility of polar exploration that are worthy of being remembered—

"Were I asked to enumerate all the possible advantages of arctic explorations, I should say frankly I cannot do so, any more than I or any one else could have said, fifteen or twenty years ago, that an insignificant grass growing on the banks of a tropical river would make our incandescent electric light a possibility. It would not be at all strange if, in a region of the strangest contrasts, where active volcanoes are found surrounded by eternal snow and ice, and where the poppy—

symbol of warmth and sleep and luxury—blossoms at the very foot of the crags of icy glaciers, some materials were found which would make possible some yet unknown necessity of our future civilization.

"But suppose we admit that arctic exploration is only a matter of sentiment, with no money return, no increase of commerce, no fruit of colonization, no harvest of great good for many men. Let it stand as a sentiment; it has good company. Love and patriotism and religion are matters of sentiment, and we ask no money return for them."

THE RESOURCES AND MEANS OF COMMUNICATION OF CHINA.*

By GEO. G. CHISHOLM, M.A., B.Sc.

"We are on the eve," says Mr. Colquhoun, "of an industrial development in China which will revolutionize the world."† It is many years since such a revolution has been anticipated as destined to come about sooner or later by many of those acquainted with the resources of China, though it is only quite recently that that country has come to engage the attention of all the world. What the precise nature of the economic changes likely to ensue on the complete opening up of China may be, it is impossible to foretell. They are sure to be complex, but they are sure to be great. Looking at the future dispassionately, and laying aside all national bias, one may say that the process of evolution likely to go on within the next generation, through the application of modern methods of production and transport in China, may be expected to be as interesting as any that has taken place in history since the discovery of the seaway to India, or, at least, since the introduction of steam-driven machinery into Europe. The present time, therefore, is opportune for considering the facts, and with that view the present article and the accompanying map have been prepared.

Density of Population.

That the indications on this head furnished by the map can be taken only as rough approximations hardly needs to be mentioned. The data on which such indications must be based are altogether too uncertain to make it worth while, or even reasonable, to enter into nice calculations. I will merely state, therefore, that the figures on which the indications on the map are founded are those contained in the eighth number of the *Bevölkerung der Erde* (Gotha, 1891), p. 105, where the total population of China proper, excluding Manchuria, but including at that time Formosa (to which a population of 3,000,000 is ascribed), is taken at 350,000,000 in round numbers.‡ The grounds on which this total and its distribution among the several provinces are based are set forth in the pages preceding the table referred to.

Whatever may be the truth as to the absolute numbers of the population of China, there can be little doubt that the different tints on the map at p. 552 give at least a fair indication of the differences in density of population of different

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* Map and Sections, p. 552. † 'China in Transformation,' p. 152.

‡ For a much lower estimate (282,000,000), and the reasons on which it is based, see a paper by Sir Richard Temple, in the *Jour. Stat. Soc.*, vol. xlviii. pp. 1–20.

regions. Having for the most part only provincial estimates to depend on, I have generally made the boundaries of the provinces the limits of the tints for density of population; but in some cases I have departed from this rule in order to take account of known facts with respect to the relative aggregation of population. Obviously another element of guesswork with reference to actual numbers is thus introduced, but it seemed to me, nevertheless, better to face that necessity than to ignore facts of significance to which it is important to draw attention.

Products and Mineral Resources.

The names of the vegetable and animal products of China written on the map will, of course, not be understood to include all the important products of the kind. They are written only where they are locally characteristic, and hence some of the most important are omitted, because universally distributed or extending over too wide an area to be indicated as belonging to any particular localities.

The mineral resources of China are well known to be enormous, and if we look to the future, the most important of these is, beyond all question, coal. On the map, I have indicated, in accordance with Richthofen's map opposite p. 754 of vol. ii. of his work on China, the areas in the north-east of China where coal-bearing strata are believed to occur either superficially or beneath the surface. For the remainder of China, I know of no such data, and for large areas we are still altogether without information. I have shown also, on the strength of various authorities, the situation of the chief localities in which coal is actually mined, or seems to be most promising for mining industry in the near future.

Two coal-bearing regions in China stand out above all others—eastern Shansi in the north, and southern Hunan in the south. The anthracite field of the broken plateau of eastern Shansi is probably the most remarkable coalfield in the world. I have given elsewhere * a somewhat detailed account of this field from Richthofen's description of it.† Here there is only space to say that it is a continuous field of about 13,500 miles in area, composed of fuel equal to the best Pennsylvanian anthracite, with seams up to 40 feet, and everywhere one of at least 15 to 20 feet in thickness, and in many places workable by means of level adits. The western half of the same province (west of the Ho-shan range) is nearly as rich in bituminous coal as the eastern half is in anthracite, and there is an important detached and depressed outlier of the anthracite field, only about 150 feet above the plain, in the neighbourhood of Hwaiking-fu, north-east of Honan, in the portion of the province of that name lying north of the Hwang-ho. Few mines, according to Richthofen,‡ are better situated than these last for the application of steam-power.

"The whole of south-eastern Hunan," says Richthofen, "may not unjustly be called one great coalfield." § The extent of this field he estimates at 21,700 square miles, but more than half of that area he states to be covered by sedimentary deposits of many thousand feet in thickness. The mines being, as shown on the map, in a convenient situation for water-carriage, some in the valley of the Siang, above Siangtan, others in that of the Lei, or, as Richthofen calls it, the Lui, the production is already considerable. The Siang mines yield only a semi-bituminous coal of extremely poor quality, but the Lei valley mines yield mainly anthracite,

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* *Jour. Stat. Soc.*, vol. liii. (1890), pp. 585-586.

† 'China,' vol. ii. pp. 435, 439-440, 471. Letter III., pp. 14-16. (Throughout I have referred in this way to the seven letters written by Richthofen to the Shanghai Chamber of Commerce about twenty-eight to thirty years ago.)

‡ 'China,' ii. pp. 401, 402.

§ Letter I., p. 5.

some poor, some excellent.* In the Lei valley Richthofen believed that nothing but anthracite was produced, but Morrison found bituminous mines there also.†

Coal is also mined in the west of the province, in the departments of Shinchau-fu and Yuenchau-fu, but Richthofen was unable to learn the precise localities of production.

Sze-chuen may also be included among the provinces extremely rich in coal, though I have been able to get little information with regard to the exact spots in which it is mined. "Coalfields," says Mrs. Bishop, "appear to underlie the whole surface of Central and Northern Sze-chuen."‡ Coal is also largely mined. On the Kialing river, Mrs. Bishop tells us, the coal traffic is enormous. At several points she saw coal-yards fully an acre in extent, stacked to a height of 8 feet with coal in large blocks.

Among the mines of Pechili, those of Kaiping are interesting as the first in China worked under European management and by European methods, and the first to be connected with a port by rail. Those of Fangshan-hsien, about 35 miles south-west of Peking, are the mines that supply the capital with its fuel (a tolerably good anthracite), which is conveyed by means of the Liuli-ho and other streams.

With reference to the occurrence of coal in Kansu and other parts of northern China, it may be noted here that at no distant date it is likely to derive increased importance from the great supplies of wool obtainable in this region. At present woollen clothing is little used in China. Furs and padded cotton garments are the only means of warding off the severity of the winter cold. But it can hardly be doubted that woollen clothing would form a convenient and favourite wear if it could be procured cheap enough. That this is already perceived by the Chinese themselves was shown in an interesting manner by the experiment of Tsotsungtang, the governor of Shensi and Kansu, who succeeded in suppressing the Mohammedan rebellion in the north-west. A woollen factory was started by him at Lanchau-fu, at first with machinery of his own contriving,§ and when this, naturally enough, did not succeed, was equipped with the best European machinery. This failed too, but its failure, according to Rockhill, was due to carelessness and rascality ‖ (whose he does not say), and the attempt may be taken, nevertheless, as an indication of what the future is likely to bring forth.

Of the coalfields of Shantung, that of Poshan, east by south of Tsinan-fu, is at present the most productive; but that of Changkiu-hsien further west, though more expensive to work by Chinese methods, is believed by Richthofen to be really the most important of all in the province, and that of Ichou-fu and I-hsien, the most southerly coalfield of the province, is also regarded by him as possessing all the requirements for playing a great *rôle* in the future.

In addition to coal, iron ores are widely diffused in China, but at present only those ores which can be most easily smelted by native methods are made use of. Such ores exist in great abundance throughout the anthracite field of Shansi, where an important iron industry has long existed, and is likely to grow into much vaster proportions hereafter. On the map are indicated two districts, one in the north and one in the south, where the ores are already largely worked. The southern iron mining and working district is what is known as Fengtai, the chief town and centre of the industry being Tsechau, though the wares produced are generally known, and

* G. J. Morrison in *Proc. R.G.S.*, 1880, p. 160. † Ibid., p. 161.

‡ *Geo. Jour.*, vol. x. p. 21.

§ See Michaelis, 'Reise von Hankou nach Sutschou,' Ergänzungsheft, No. 91, to *Petermanns Mitteilungen*, p. 31, col. 1.

‖ 'Land of the Lamas,' p. 36.

have been known for more than two hundred years, as Lu iron, from the town of Lungan-fu further north, which is the chief centre of distribution. The chief iron mining and smelting centres in the north are Loping, to the south of Pingting-chau, where a very pure brown hematite mixed with spathic iron ore is found; and Yi-hsien, to the north of Pingting-chau—this town, standing on the main road connecting the eastern plain with the interior of Shansi, being an important centre of the iron industry, using both the raw iron of Yi-hsien and the wrought iron of Loping.

In the coal-producing region of Hunan, on the other hand, iron ores are only sparsely distributed; but two places are mentioned by Morrison as producing ore which is locally smelted. Both of these I have shown on the map, one to the south-east of Heng-chau, and the other near Chen-chau.

The fact of coal and iron being found near one another has also developed an iron industry in Manchuria, at Liauyang, to the south-west of Mukden, at Saimaki, near the Korean frontier, and above all at Pen-hsihu, to the south-east of Mukden, coal occurring in abundance at that place, while excellent magnetic iron ore is mined to the south.

With regard to most of the other minerals of importance, the map must be left to speak for itself; but it may be mentioned that the copper mining for which Yunnan has long been famous was greatly injured during the Mohammedan rebellion, some of the chief mines having been flooded then, and not since worked.

The tin-mines of Yunnan are confined to an area of about 10 square miles in extent among the mountains a few miles to the west of the city of Mengtse or Mongtse, the treaty port, or rather imperial customs station, in the neighbourhood of the Red River, opened under the second article of the *Convention additionelle* signed between China and France on June 26, 1887. The chief mining centre is Kochiu, or Kiochiu, about 10 to 15 miles west of Mengtse. Besides tin, silver, lead, and iron occur in the district, but tin-mining has always been of most consequence there.

Means and Cost of Transport.

From what has been stated above, especially as to the mineral resources of China, it will be tolerably evident that China possesses enormous stores of wealth, the value of which depends upon adequate means of communication and transport. Now, the fact is, that except where there is easy communication by water, the cost of transport in China, notwithstanding the extraordinary cheapness of labour, is exceptionally high, and it is probable that even on the better class of waterways the cost of carriage might be considerably if not very greatly reduced.

A few data in illustration or enforcement of these propositions will probably be found of interest. According to Richthofen, the cost of transport by land in China, whether by carts, animals, wheelbarrows, or men, may safely be put at $3\frac{1}{3}$ to $3\frac{2}{3}$ cash per li per picul.* This works out to about 7·2*d.* per ton per mile, the li being taken at Richthofen's usual rate, 3 li = 1 geographical mile (60 to 1°), and the tael (1600 cash) at 6*s.* 4*d.*, which was about the value when Richthofen wrote. The picul is $133\frac{1}{3}$ lbs., or 16·62 piculs = 1 ton. In western China, according to Mr. Colquhoun, the cost of carriage for heavy goods, such as salt and pressed cotton, is on an average 1*s.* per ton per mile.†

There are parts of China where the cost of land carriage is lower. In Yunnan,

* Letter III., p. 7.

† 'China in Transformation,' p. 103.

generally, the cost of carriage by caravan is estimated by F. S. A. Bourne at about 2½*d.* per ton per mile.* But that seems to be exceptional, and may be due to the extreme poverty of the province. According to the data furnished by Richthofen † and Baber,‡ the rate paid to the tea-carriers from Yachau to Tachien-lu would amount to 1*s.* 3*d.* per ton per mile, the average load being taken at 224 lbs., or 10 "theoretical catties;" according to those furnished by Rockhill, it amounts to about 8*d.* per ton per mile.§ That, however, is a route of exceptional difficulty. A more striking case is that furnished by Markham ‖ as to the cost of carriage of coal to Wei-hsien, in the province of Shantung, from the mines 7 miles distant (the north-eastern coalfield of the province). It amounts, he says, to from 8*d.* to 10*d.* per picul, or 11*s.* to 13*s.* 10*d.* per ton, or from 1*s.* 7*d.* to 2*s.* per ton per mile. The carriage is effected by means of carts, wheelbarrows, and donkeys. Richthofen states that at the time of his visit anthracite, which cost at Pingting-chau 1*s.* 4*d.* a ton,¶ cost at Hwolu-hsien, at the entrance to the plain, after being carried 80 miles on the backs of asses, 68*s.*, an addition of 10*d.* per ton per mile to the original cost.

In order to compare these figures with the rates charged in countries where the means of communication by land are better than in China, I am able, through the kindness of a friend, the manager of a Scotch colliery near Kilmarnock, to give an example very apposite to that of the carriage of the coal from the mines near Wei-hsien to that city. He informs me that down to 1872, when the railway became available, the average cost of carriage of coal by cart from the mine in question to Troon or Irvine, each about 9 miles distant, was equivalent to a trifle more than 2*s.* per ton, or about 2·7*d.* per ton per mile, little more than one-third of the general average given by Richthofen, little more than the much smaller average given by Bourne for Yunnan, and only a small fraction of that charged from the mines in Shantung to Wei-hsien.

If railway charges are compared, the following (for finished iron and steel goods) may be noted:—

From Staffordshire to London, 1·33*d.* to 1·50*d.* per ton per mile.
From Liège to Antwerp, 0·51*d.* per ton per mile.**

Coal is carried by rail in England at from ½*d.* to a 1*d.* per ton-mile, and in the United States for much less.††

It is such facts as these that warrant the belief that a tremendous economic revolution is bound to be brought about by supplying China with the means of transport already introduced into other parts of the world.

There is less difference between the cost of carriage by inland waterways in

* 'Foreign Office Report,' Miscel. Series, No. 458, p. 57.
† Letter VII., p. 70.
‡ 'Travels and Researches in Western China,' pp. 194, 195, 197.
§ 'Land of the Lamas,' pp. 299–301.
‖ *Proc. R.G.S.*, vol. xl. (1870), p. 211.
¶ At some of the mines the cost is under 6*d.* a ton.
** 'Report of the Delegates of the British Iron Trade Association to inquire into the Iron and Steel Industries of Belgium and Germany" (1896), p. 14.
†† In a paper read before the North of England Institute of Mining and Mechanical Engineers on April 10, 1897, Mr. Jeremiah Head, M. INST. C.E., stated that at the time of his visit to the south-eastern mining and iron-working districts of the United States, coal was carried from Birmingham, Ala., to Pensacola, a distance of 258 miles, for 4*s* 6*d.* per ton, including shipping charges, or, say, 0·2*d.* per ton per mile.

China and that in other countries, and for the most part the difference appears to be to the advantage of China. The average of about 7*d.* per ton per mile given above on the authority of Richthofen as the general average for China, is stated by him to be from twenty to forty times as great as that for rivers of easy navigation,* so that, he says, it is the length of transportation by land which comes almost solely into consideration in that country. This is, of course, specially true of southern China, where alone water-carriage enters generally into competition with land transport. A land carriage of 20 miles takes away all profit in the trade in Hunan coal.† Here it may be incidentally pointed out that this fact speaks volumes for two things—first, the great value of the anthracite of Shansi, which, as above stated, will stand the charges of an exceptionally costly land journey of 80 miles through a mountainous country in order to reach, not a waterway, but the edge of the plain; and, second, the greatness of the difference in the economic situation that the introduction of an improved means of land transport in that region is likely on that account to accomplish.

But notwithstanding the great difference that already exists in China between the cost of land and water carriage there seems to be good reason for believing that, at least in the better waterways of that country, considerable economies might be effected by the introduction of modern methods of carriage. Travellers seem in many cases to have an inadequate idea of what can be accomplished by means of light-draught steamers, or have made statements that may have been true enough when they wrote, but are no longer true now that great improvements have been made in the construction of such steamers.

Richthofen regards the Siang-kiang in Hunan as unsuited for steam-navigation.‡ Mr. Morrison did not think a steamer drawing more than 3 feet could run regularly on that river as far as Siangtan,§ and above that point there are, he says, some shallow places where the stream runs very fast, which would probably be insuperable difficulties in the way of steamboat traffic. Dr. Kreitner considered Fancheng, opposite Siang-yang, on the Han river in Hupeh, as the probable limit of steam-navigation during the winter (low water), although he states that at Lahokou, about 70 miles higher up, the winter depth is from 3 feet 3 inches to 5 feet, the width about 220 paces, and the current only about 2 feet per second.‖ Light-draught steamers now navigate much shallower waters than these, and it is particularly worthy of note that such steamers are capable of carrying a much larger cargo than is usually conveyed in junks on Chinese inland waters. The highest carrying capacity of any vessels that I have read of anywhere in China, except on the Yangtse below Ichang, is 150 tons.¶ In view of these facts and statements, it may be worth while to insert here the following particulars, showing the dimensions and carrying capacity of small, medium, and large light-draught river steamers, from a table with which Messrs. Yarrow & Co., shipbuilders, Poplar, have been kind enough to furnish me:—

* Letter III., p. 7.

† 'First Decennial Report of the Imperial Maritime Customs,' p. 173.

‡ Letter I., p. 10.

§ *Proc. R.G.S.*, 1880, p. 158.

‖ 'Die wissenschaftlichen Ergebnisse der Reise des Grafen Béla Széchenyi in Ost-Asien, 1877-80' (Vienna, 1893), p. 110.

¶ Junks up to this size navigate the rapids of the Yangtse between Ichang and Chungking, but they are comparatively few, the larger junks on this passage having for the most part a carrying capacity of only 60-70 tons ('First Decennial Report of the Imperial Maritime Customs,' p. 135).

Length.	Beam.	Draught (light), steam up.	Speed (light), steam up.	Load carried on— 12 inches.	18 inches.	24 inches.	36 inches.
Feet.	Feet.	Inches.	Miles.	Tons.	Tons.	Tons.	Tons.
70	14	9½	8½	4	13	23	43
100	20	11½	10½	2	21	40	81
180	36	12	13	0	61	124	259

In the case of the Siang river, it seems to have been the remarkably low cost of carriage by native boats than the nature of the stream that induced Richthofen to think it would be vain to attempt to introduce steam-navigation for the coal traffic there. At the time of his visit, the cost of the carriage of coal on the part of the river easiest to navigate, and on the Yangtse, from Siangtan to Hankau, a distance of 273 miles, was 36,000 cash per 400 piculs, which is equivalent to 0·263*d.* per ton per mile, the tael being taken at 6s. 4*d.* "No steamer and no railroad would carry coal," he says, "for so low an amount as the boatmen of Hunan do." * But, with reference to this opinion, one cannot help asking whether the nature of the river makes it utterly impossible to imitate in any degree the system of tows (barges lashed together and propelled—that is, pushed by single stern-wheel steamers) practised on American rivers, and ensuring on the Ohio and Mississippi, it is boasted, the cheapest carriage in the world. By one such tow, consisting of 38 pieces, as much as 25,900 tons of coal have been sent down from Louisville at one time, and by the same system coal has been conveyed from Pittsburg to New Orleans, a distance of 2000 miles, at 60 cents (half a crown) per ton. This is equivalent to a rate of only 0·015*d.* per ton per mile.† No doubt the rivers of China do not allow of the system being practised there on this gigantic scale, but is it quite impossible to effect any economy by applying it at all? Low as the Chinese rate is, the margin in favour of the American rate is considerable. It is scarcely possible to believe that no economy can be brought about by the introduction of so manageable an agent as steam in some way or other. Probably, therefore, the throwing open of all the rivers in the provinces of China containing treaty-ports will prove to be a very important concession for the development of the empire on Western lines.

Inland Waterways.

In addition to the foregoing general observations, some further notes are required in elucidation of the map so far as it indicates the inland navigation.

It must be stated at the outset that the indications there given are far from complete. I have inserted no indication except where I have been able to procure more or less definite data, and I have not always been able to procure particulars of the same kind for different rivers. This makes it impossible to make such a map self-explanatory.

* Letter I., p. 6.

† U.S. Census, 1890. 'Report on Transportation Business,' Part II.: 'Transportation by Water,' p. 410. The figures there given show that this system of transportation must be well adapted to meet competition, which has been telling severely on the ordinary steamer traffic of the rivers. While the amount of freight moved on steamers in the Mississipi valley decreased from 13·56 million tons in 1880 to 10·35 millions in 1889, that carried on the tow system increased in the same interval from 5·39 to 19·06 million tons (254 per cent.). The increase on the Ohio was even more striking—from 2·52 to 12·23 million tons (385 per cent.), against a decline in the ordinary steamer traffic from 9·2 to 3·8 million tons.

Throughout China the navigability of the rivers is greatly affected by the regular occurrence of high and low water, high water occurring in the summer and early autumn—that is, during and immediately after the summer (monsoon) rains. The difference between high and low water is in some cases enormous. At Ichang, on the Yangtse, the height of the river varied in the ten years, 1882-91, between 1 foot 5 inches below low-water mark (on March 21, 1889) and 46 feet 2 inches above low-water mark (on July 12, 1883). At low water the depth on the south bank is in some places 10 to 12 fathoms. High water continues at this place from the beginning of July to the end of September.*

These fluctuations affect the navigation in various ways. Where rapids occur, the time of low water is generally the most convenient for navigation, especially up-stream, owing to the extreme difficulty of overcoming the velocity and force of the current. This fact limits the usual size of the boats employed in such stretches. Winter is accordingly the usual season of navigation on the Yangtse between Ichang and Chungking, which makes an unfortunate break in the connection with the navigation of the part of the river below Ichang. For between that port and Hankau, on account of the occurrence of certain shoals at low water, the most serious being at Sunday island (at the sharp bend of the river south of Shashi, north of the Tung-ting lake), the most convenient period of navigation is that of high water. Whether the rapids of the Yangtse could be navigated by steamers during high water is doubtful. Up to the present time only one steamer, a launch, as the owner, Mr. Arch. Little of Shanghai, has kindly informed me, 55 feet long and 10 feet wide, has ascended this portion of the river, and it arrived at Chungking on March 8 (this year), after a three-weeks' voyage.

On the upper, mainly west to east, portion of the Han, where the river runs through mountainous country and rapids are exceedingly numerous, high water renders progress up-stream very slow, so that in summer it takes about five months to ascend from Hankau to Hanchung, while under the most favourable conditions this ascent may be accomplished in about half that time.†

In the lower Han high water creates a difficulty of another kind. While the banks of the Yangtse are always visible, the natural banks of the lower Han are completely submerged at high water, and for long distances (between Yokou and Iching) not a tree or a house is visible to mark their situation.‡ Hence there is great difficulty in keeping to the navigable channel.

I have endeavoured to indicate on the map in certain cases the limit of navigation for larger vessels, but this also requires some explanation.

In northern China, so far as I have been able to ascertain, only the smaller class of junks are made use of. As is well known, the Hwang-ho, the longest and largest river of all northern China, is of very little use as a waterway, in consequence partly of its rapidity, partly of its shallows. The lowest navigable stretch on this river is indicated in accordance with the statements of Richthofen.§ On this stretch, he says, the boats should not draw more than 3 feet, and most of them draw only 1 foot. Above Meng-hsien, the upper limit of this stretch, situated close to a ford celebrated and strategically important in early Chinese history, the river, he states, is properly not navigable to the great bend. Above this latter point it becomes navigable again as high as Lungmen‖ (the "Dragon-gate"), but on this part of its course it

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* 'First Decennial Reports,' etc., pp. 143, 144, with accompanying diagram.

† *Proc. R.G.S.*, 1890, p. 64. ‡ Richthofen, Letter II., p. 2.

§ Letter III., p. 7.

‖ Erroneously marked on the map as a town. The name recurs in China for the mouth of a rocky gorge.

is little used except for the conveyance of coal, generally on rafts, from the mines at Hotsin-hsien, near the confluence of the Fen-ho, to Yenyang-hsien, on the Wei, the river-port of Singan-fu. On the west side of Shansi, above Lungmen, the river is entirely unnavigable; but higher up, between Ning-hia and Bautu (Pautu, or Pauto), there is considerable wool and grain traffic down-stream, the boats being towed up-stream (? empty).* Mr. Littledale rafted down the river from Lanchau-fu to Ning-hia, passing a bad rapid on the second day. The dimensions of the raft were 50 feet by 18.†

Both Richthofen and Ney Elias took Lungmenkau, a little below the point where the Hwang-ho finally turns north-east, as the lowest limit of navigation on that river. Mr. Morrison, however, states that at the time of his visit (1878) large boats, drawing probably 7 or 8 feet, could come up from the mouth as far as Chiho (or Tsiho) -hsien (nearly due west of Tsinan-fu), and adds that all the heavy machinery for the arsenal at Lokou, the river-port to the north of Tsinan-fu, was brought up the river.‡ Whether the mouth of the river is still to be regarded as navigable after its change of course in 1887 and subsequent restoration to its former bed, I have not learnt.

On the Wei, the great tributary of the Hwang-ho, navigation, according to Dr. Kreitner, is confined to the portion below the place already mentioned, Yenyang-hsien, and even on this portion he adds that it is of subordinate importance—a fact that is somewhat surprising when we consider that he found the depth here, in February, to be from 2 to 3 metres.§

I have marked the northern limit of easier navigation on the Grand Canal at the old bed of the Hwang-ho, because from this point southwards it is a fine water-way affording uninterrupted communication to Shanghai, while north of that point it is at a higher level, and, there being no locks, the passage of boats upwards is "well-nigh impossible."‖ In the rare cases in which this is done, sluices are opened against the current, which may be flowing at a rate much beyond 10 miles an hour. In the southern section of the canal, below the limit indicated, boats drawing at least 5 feet were constantly running at the time of Mr. Morrison's visit, while in the northern section there were many places not 3 feet deep.

With regard to the navigation of the Yangtse and the Han, nothing need be added except that, according to the First Decennial Report of the Imperial Maritime Customs,¶ the best kind of steamer for the Hankau-Ichang traffic is a powerful single stern-wheel vessel of a carrying capacity of 600 tons, with a draught not exceeding 5 feet, and an average speed of from 10 to 12 knots, if possible.

Though the province of Sze-chuen has so many navigable rivers of the Yangtse basin, these differ greatly in value. While, for example, the Lu-ho, Tung, or Tatu-ho is marked as navigable like other rivers of the Red basin, it is little suited for navigation anywhere on account of its numerous rapids, and in part of its navigable course it is practicable only for rafts, and even for these is so dangerous that the owners of the timber have to make the ominous stipulation to provide the raftsmen with coffins in case of fatal accidents.** The most important water-ways of this part of the Yangtse basin are the Min, which is regarded by the Chinese as the true headstream of the Yangtse, and the Kialing, or, as it is called at Chungking, the Siao-ho, or Little river, already referred to for its coal traffic.

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* *Geog. Jour.*, vol. iii. p. 470.
† Ibid., pp. 468–470.
‡ *Proc. R.G.S.*, 1880, pp. 150, 151.
§ Béla Széchenyi, 'Die wissenschaftlichen Ergebnisse,' etc., pp. 131, 132.
‖ *Proc. R.G.S.*, 1880, p. 146.
¶ P. 129.
** Baber, 'Travels and Researches,' etc., p. 45.

This is one of those rivers which will probably acquire much greater importance through the introduction of steam traffic. At Paisuikiang, where the navigation begins on the borders of Kansu and Shensi in about 33° 50′ N., it already has a depth of 10 feet.* According to the Foreign Office Report, Miscellaneous Series, No. 457, the capacity of the junks that ascend as high as Pao-ning-fu is 30,000 catties (about 18 tons). Mr. Arch. Little has been good enough to inform me privately that there are some junks on it over 100 feet long, 11 feet beam, and 5 feet draught, yet carrying only about 50 tons.

It is in the south-eastern part of China that our map is most inadequate in representing the Chinese waterways, which are in all parts of this region the most important means of communication, though varying greatly in the facilities they afford for it. This is the region traversed by what Richthofen calls the Nanshan or Hilly Belt of the south-eastern provinces, and here, says Richthofen, denudation has been active for so long a time, that much of the unevenness of the surface has been smoothed away, and almost all the rivers are in some sort navigable streams, according to the ideas and practice of the local Chinese. Many of them are full of rapids, but various circumstances combine to enable the Chinese to make use of these rivers for navigation in spite of obstacles which could not be encountered with success in Europe. They drag their boats over rapids that would be regarded by us as putting an end to navigation, and across where the water flows with great velocity over pebbly ground at the depth of 1 or 2 inches.† In the future we may expect such rivers to be superseded entirely by railways, wherever it is worth while to lay railways along their valleys, while the rivers of easier navigation will no doubt continue to be made use of, at least for the heavier traffic.

I have represented the Siang river as of easy navigation as high as Heng-chau. This I have done on the strength of a recent Foreign Office Report (No. 2126 of the Annual Series), where, on p. 10, it is stated that a recent survey has shown that steamers drawing not more than 9 feet could get there at any time. If this is correct, it is strangely at variance with the views of Richthofen and Morrison above referred to.‡ The connection of the upper part of this river by canal with the Fu-ho or Kwei (a river full of shallow rapids §) on the other side of the mountains, in Kwangsi, is available only during the rainy season for boats drawing not more than 2 feet.‖ None of the other main streams entering the Tungting lake is to be compared with the Siang as a waterway. On the Yuan, rapids begin about 45 miles above Changte-fu, and continue all the way up. Freight on it is about seven times as high as on the Siang. The Tse is navigable only by the smallest kind of boats.¶

In Kiangsi, the Kan- (or Kia) kiang, the main artery of the province is extremely difficult to navigate in its upper reaches,** though it is used as a waterway up to Nanngan (Nan-an) at the foot of the Meiling pass, that town having formerly (before the interruption of the Grand Canal) been the terminus of an inland line of waterways beginning at Peking. Several of the other streams of the Poyang basin are more or less important in the same respect. In the north-east, the limit of "still and deep water" is stated by Richthofen †† to be 120 miles above its mouth in the direction of Kintechin and Loping—that is, on the north-east branch of the Po river, which is valuable as a carrier of "keemun" tea, as well as porcelain.

* Béla Széchenyi, 'Die wissenschaftlichen Ergebnisse,' etc., p. 217.
† Richthofen, Letter IV., p. 7.
‡ P. 505.
§ *Proc. R.G.S.*, vol. xxxviii. (1868), map opposite p. 51.
‖ Ibid., p. 61.
¶ Richthofen, Letter I., p. 3.
** Ibid., Letter IV., p. 7.
†† Letter I., p. 10.

from the imperial factory at Kintechin, and the eastern branch, which carries down "moyune" tea and Loping coal. The Shang-jao, or Kin-kiang, the next river to the south, on the same side, forms the main avenue to the province of Chekiang, and carries down chiefly paper, while the Fu-ho, still further south, flows through a valley yielding tobacco, hemp, and grass-cloth.

In the deltaic region of Kwantung the waterways are naturally numerous. On the Si-kiang I have marked Wuchau-fu as the limit of easier navigation, this being the place up to which, according to Agassiz,* steamers of 8 feet draught might ascend.

British steamers of 7-feet draught are now running regularly to this point,† and, according to Mr. Colquhoun,‡ it is quite certain that this river could be opened to steam-navigation as high as Nanning.

Railways and Railway Projects.

That the means of transport at present in use are totally inadequate to open up the enormous resources of China is obvious. It is also known to every one that nothing but the hostility of the Chinese government has prevented the introduction of railways into the country long ago. The first railway in China, from Shanghai to Wusung, was laid in 1876, and was eagerly made use of by the people; but in the following year it was bought and torn up by the authorities. The next line made was that from the Kaiping collieries to navigable water, ultimately continued to near the Taku forts on the Gulf of Pechili, and now replaced by a well-made line running from this point to Tientsin and Kaiping, and thence north-eastwards by Shanhaikwan into Manchuria. In the summer of 1897, a line 73 miles long, from Tientsin to Peking, laid by British engineers, was opened, and so largely has this been taken advantage of that its doubling is now in rapid progress, and is expected to be completed in the autumn of this year. Another railway, running southwards from Peking, and ultimately intended to reach Hankau, is now in course of construction, under a concession to a Belgian company, and has already been completed as far as Pauting-fu, its first portion running parallel to the road, and close to the headwaters of the navigable rivers of this district.§ A branch is being made to the mines of Fangshan-hsien, which supply Peking with anthracite. An industrial line for the conveyance of iron ore from the mines of Tiehshanpu in Hupe to a point on the Yangtse, about 70 miles below Hankau, constructed by the viceroy for the supply of the great ironworks erected by him at Hanyang, was opened in 1892. A second railway from Shanghai to Wusung was opened in August this year. So far these are all the lines already existing in China.

It seems likely, however, that railway construction will now go on apace. "Once judiciously begun," says Mr. Colquhoun, "who can doubt the rapid and profitable extension of the railway throughout China?"‖ It must be borne in mind that when once a single great trunk line has been established, the present economic equilibrium in the country will be disturbed, and the regions that are thus prejudiced, though now perhaps indifferent or hostile to this innovation, will begin to clamour for it. Numerous projects for Chinese railways have accordingly long been set forth, and in what follows I give for the most part an abstract of the schemes suggested by the late Dr. Kreitner, and expounded by him in great detail in vol. v.

* *Proc. R.G.S.*, 1891, pp. 256–260.

† 'Foreign Office Report,' Annual Series, No. 2108.

‡ 'China in Transformation,' p. 138.

§ See the account of a journey along the route in 'Foreign Office Report,' No. 466.

‖ 'China in Transformation,' p. 92.

of the *Revue Coloniale Internationale*. This is the most comprehensive and minute study of the subject with which I am acquainted, and several of the routes proposed and examined by him are identical with those for which concessions have been obtained or are being asked for.

Dr. Kreitner begins with the consideration of three proposals that had been made for the connection of the Russian railway system of China—that of Meissel by Kiakhta and Urga to Peking; that of Bogdanovich by Chita, Khaitu, and Dolon-Nor (Lama-Miao) to Peking; and that of Richthofen by Semipalatinsk and Hami to Singan-fu. Since Dr. Kreitner wrote, however, political events have made it certain that the first connection of this kind will be made further east, by means of the Trans-Manchurian line to be constructed under an agreement between Russia and China, and expected to be completed by August, 1903.

A connection with this line by a continuation of the Tientsin-Shanhaikwan line cannot fail to be brought about, and this will probably prove of the utmost importance for the conveyance of agricultural produce. For many years Manchuria has been in a large measure a Canada for China proper, increasingly so in recent years; the development of the great northern coalfields of China and of the industries likely to be associated with that development is bound to create a great demand for food-stuff, for a mining and industrial population, and no region seems better fitted to supply this demand than Manchuria. Since our map was printed, the extension of the Shanhaikwan line in the direction of Niuchuang and Hsi ming ting (? Sinmin tun) has been arranged for under a contract with the Hong-kong and Shanghai Bank.

But the carrying out of these Manchurian projects would not hinder the realization of one or other of the schemes mentioned above for establishing a more direct connection with the Trans-Siberian railway, and of these three schemes Dr. Kreitner adheres to that of Richthofen, treating it as part of a great railway line ultimately to connect Peking with the middle of Siberia. If only geographical and economic considerations are taken into account, such a railway will undoubtedly be required.

This railway Kreitner calls the North China railway. Its total length from Peking by the Hwang-ho valley route (south of Shansi) to Singan-fu, and thence to Ansi-chau (Ngansi-chau) on the south side of the desert route, is given by him at 1840 miles. The first part of this route is that which has already been constructed to Pauting-fu, and which is common to it, the Taiyuen (Shansi) line and the Hankau line. On this route no difficulties whatever would be encountered till one had passed Meng-hsien, the place already mentioned at the upper limit of the lower Hwang-ho navigation as shown on the map, a few miles below the mouth of the defile of the Hwang-ho; but above that point as far as Tungkwan (the town situated near the sharp bend where the Hwang-ho changes its course from south to east) there are serious obstacles, due to the fact that loess precipices 150 to 300 feet high descend sheer down to the river, now on the right bank and now on the left. The precise alignment could be determined only after a careful survey. There would be no engineering difficulties in bridging the Hwang-ho at Tungkwan, though the left bank here descends perpendicularly to the water's edge in a precipice 260 feet high, while the right rises in terraces to about 650 feet in places. The bed is here sandy, the water shallow, and the banks firm, and in spite of the small breadth of the stream, about 700 feet, the bed contains some shallows and banks which would favour the erection of piers. Between Hwaiking-fu and Tungkwan a different route is suggested by Richthofen, his line first running south-west to Honan-fu (crossing the Hwang-ho at the ford of Meng-hsien), then westwards on the right bank of the river.*

* See Map 3 to 'Schantung und seine Eingangspforte Kiautschou,' by Ferd. Freiherr von Richthofen. Berlin, 1898.

From Tungkwan to Singan-fu* there would be no difficulties, but beyond Singan-fu, to follow the present cart road (shown on the map) would be no easy matter, as might be guessed from the section on the sheet following our map (based on that by Dr. Michaelis on Plate II. to *Ergänzungsheft*, No. 91, to *Petermanns Mitteilungen*).

The more southerly route up the valley of the Wei, and thence north to Anting (Nganting-hsien), would be easier and cheaper. Difficulties on this route as far as Pauki-hsien are absent, but west of that point the Wei valley contracts and appears to retain a ravine-like character to the mouth of the Si-ho (east of Tsing-chau). Of the nature of this gorge nothing definite is known, but from the aspect presented by the valley of the Wei when seen from the heights to the south of Tsing-chau, it may be concluded that in this portion of the route a good deal would have to be done in the way of blasting, construction of stone embankments, protecting walls, and so forth.

For the bed of the railway on the Lanchau-fu Kulang-hien stretch there is ample stone, but iron or stone would have to be used for sleepers. Water and fuel are abundant, there being rich coal deposits at Lanchau-fu, Pingfan-hien, and Kulang-hien. Beyond this point, as far as Hami, no physical difficulties worth mentioning would be encountered.

One of the lines for which a concession has actually been granted, would branch off from this line in Pechili for the anthracite field of Shansi and the town of Taiyuen-fu. It would follow the present cart-road through a country of considerable difficulty, as already indicated, and as shown by the altitudes given on sheet 15 of Richthofen's Atlas. Starting at an altitude of 255 feet at Hwolu-hsien, at the edge of the plain, it first rises to 2840 feet, then descends to 2350 feet, in order to rise again to 2860 feet at Pingting-chau, and beyond that ultimately crosses a pass 4850 in height before descending to the plain of Taiyuen-fu.† The concession has been granted to the same Anglo-Italian company as has obtained the right to work the minerals of the province, and arrangements are said to have been made with the Russo-Chinese bank for the actual construction.

Another line for which a concession has been granted (nominally to a Belgian company), is one following the Peking—Singan-fu line of Kreitner as far as Weihui-fu, and proceeding thence southwards to Hankau. This line is not one of those considered by Kreitner; but, though several rivers would have to be bridged, probably no serious difficulties would be met with, except perhaps in crossing the mountains forming the water-parting between the Huai-ho and the Yangtse.

Another line diverging from the northern line at Weihui-fu is Kreitner's proposed Peking—Shanghai line, that line proceeding eastwards from Kaifeng-fu to Hwai-ngan, and then running south parallel to the Grand Canal. A branch from Hsichau could bring it into communication with the coalfield of Ichau, in Shantung. A train-ferry across the Yangtse would have to be established north of Chinkiang,

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* The altitude given on the map for this town is that of Richthofen's Atlas (1513 feet), slightly rounded, that adopted also by Bretschneider on his map; but the altitudes found by different travellers at this place are strangely divergent. The Béla Széchenyi expedition, on the basis apparently of five days' aneroid-readings in January (1879), arrived at an altitude of 1065 feet. Dr. Hermann Michaelis about the same time found one of about 1000 feet (307 metres). The altitude determined by Colonel Bell, on the other hand, was 1700 feet (*Proc. R.G.S.*, 1890, p. 62); and that of Rockhill, on the basis of a boiling-point thermometer observation, 1809 feet ('Land of the Lamas,' p. 25, and Appendix).

† See also Richthofen, 'China,' vol. ii. p. 437.

and he considers that the differences in level of the Yangtse would best be met by means of platforms capable of being raised and lowered by hydraulic pressure, as at Homberg-Ruhrort on the Rhine. On the Suchau-Shanghai section, the line would run on the north side of the "Suchau creeks" past Kwanshan.

A more easterly north-south line is regarded by Kreitner as superfluous, at least in the first instance, on account of the numerous navigable waters of the Hwang-ho plain; but, with the exception of the Grand Canal, these waterways do not form a due north-south route. Mr. Colquhoun, indeed, thinks that no railway in China would give more promise of immediate success than one from Tientsin to Chingkiang and Hangchau, and ultimately to Canton,* and the marked success of the Tientsin—Peking line seems to augur well for the prospects of another line through the most populous parts of the Chinese plain. Arrangements are now said to have been made for the construction and working of this line under joint German and British control, German management to extend as far south as the southern frontier of Shantung, while the remainder of the line is to be under British management. The German section would, no doubt, partly coincide with the western portion of that circuit of railways in Shantung for which the Germans had previously obtained concessions.

Besides the Peking—Shanghai line by way of Weihui-fu, the only railway connection between the North China railway and the Yangtse valley that Dr. Kreitner suggested, was by what he calls the Sinling (Tsinling) railway—that is, a line connecting Singan-fu with Hankau; but it can hardly be supposed that, if railways once existed in the Hwang-ho and Yangtse valleys, there would be no railway laid through the Nanchau pass in the Funiu-shan range, so as to bring Honan into connection with the Han valley by way of the valley of the Pei-ho. The pass in question is only between 1000 and 1500 feet in height, between mountains of 4000 to 5000 feet on either hand, and "the grade is so gentle, and the width of the passage so favourable, that a railroad could be built through it without the slightest difficulty."† This would be the route by which the anthracite of the great Shansi coalfield would be most easily made available in the middle Yangtse valley.

Reaching the Han valley at Fancheng (opposite Siang-yang), it would there join the Sinling line of Dr. Kreitner, the only possible direct route between the middle Yangtse and the north-west of China—one, accordingly, that may almost be regarded as inevitable in spite of no slight difficulties to be overcome.

Beginning at Hankau, this railway would meet with no difficulties in the first 45 miles to Nganlo-fu. Almost equally easy would be the section Nganlo-fu-Siang-yang (73 miles); but the Pei-ho (Pai-ho), almost 100 miles broad, would have to be crossed 5 miles below the latter city. The first difficulties, indeed, occur above Sie-kiang-kou (65 miles above Siang-yang), where—or rather at the point of the left bank of the Han-ho opposite that town—the line would leave the valley of this river and ascend that of the Sie-ho (Tan-ho). Here, in the course of 12½ miles before Likwan-chau, the line would have to traverse a valley-bottom involving in many places blastings, and the construction of embankments and protecting walls. At Likwan-chau the line begins to cross a side valley, 10 kilometres wide, whose bottom consists entirely of shingle and sand, showing that in the time of the summer rains the apparently insignificant stream may swell to a destructive torrent, so that here it would have to be carefully considered whether it would be sufficient and best to build a protective embankment, or to carry the line across a bridge supported by low stone pillars. Above Tsechuen (Sichuen), 23½ miles

* 'China in Transformation,' p. 106. † Letter III., p. 4.

beyond Likwan-chou, the gradient becomes steeper, but not more than 1 : 100, and at Kintsekwan, 22 miles beyond Tsechuen, on the section, 84 miles long, between Kintsekwan and Lungkuchai, the line would have to leave the route of the existing road or bridle-path, keeping close all the way to the left bank of the Sie-ho instead of making the ascents and descents shown in the section of Mr. Michaelis, and copied on the sheet following our map. Although in this section the average gradient would be only 1 : 430, yet a good deal of blasting and tunnelling would be required.

An easy section of 38½ miles next follows, but in the remaining 43½ miles to Mohakwan, at the summit of the Tsinling mountains, it would be necessary, in order to obtain a gradient of 1 : 100, to make a deviation of 12½ miles up a northern valley. On the other side, descending to Singan-fu (75 miles), a similar gradient would be achieved by deviating eastwards round the head of the valley of the Lantien-ho.

Dr. Kreitner, as well as others who have studied the railway question in China, have relegated to a more or less distant future the construction of any railway along the lower Yangtse valley, where there would be competition with large river steamers. A railway starting at Hankau to ascend that valley is, however, in a different position. This proposed line he called the Yangtse railway; but for the first part of its course above Hankau, it does not answer to its name, inasmuch as it follows for 112 miles the left bank of the Han-ho. This region is an extensive and very fruitful plain, traversed by numerous canals, and interspersed with small lakes and ponds. The embankments raised against inundation in this region might be utilized for the railway to King-chau.

Above this point, as high as Ichang, a few blastings of the Tiger's Teeth gorge and a short iron bridge over a small tributary which here enters the Yangtse, are all the serious works required, but between Ichang and Yinyang, a distance of 141 miles, the difficulties in the way of railway construction are very formidable. Immediately above (north of) Ichang there begins a gorge, 15½ miles long, affording absolutely no room for a railway. From a railway engineering point of view, the one advantage of this gorge is that here the Yangtse might possibly be bridged, the river being here only 1000 to 1300 feet broad, but with a depth of 18 fathoms. The route for the railway to avoid this gorge could be determined only after careful survey. After crossing this hill, it would again reach somewhat lower parts of the valley, where the difficulties at the Shantanpien and Tatung rapids, and up to the first fall of the Niukan gorge, 23½ miles above the upper end of the Ichang gorge, though moderately great, are not so formidable as in the lower part of the course just referred to. At this second gorge it would probably be easier to lay the line along the upper edge of the cliffs at the height of 230 to 260 feet above the river, than to force it along the river-banks by means of blastings, tunnels, and viaducts, and the line might be kept at the height of about 160 feet till the Mitan gorge was reached, where the cliffs on the left bank, though apparently impassable at the foot, yet seem to offer greater facilities for the laying of a railway at the height of 250 to 300 feet above the river. Special difficulties would have to be met in the upper parts of the Mitan gorge. Thence to Kui-chau (5½ miles *) the route is easy. Here there would be an important coal station, the mountains in the neighbourhood containing coal. Other 26½ miles of easy construction follow till the east end of the Wushan gorge is reached. This is the longest and most difficult of all the defiles of the Yangtse, the river being here bordered on both

* A different place from the Kui-chau (Kui-chau-fu) on our map. It is about 56 miles by rail above Ichang.

sides with little interruption by perpendicular rocky cliffs. The line accordingly would be compelled to leave the valley-bottom at Putung-hien. From this point it would run as a mountain railway above the cliffs along the side of a very steep slope, 650 to 1150 feet above the stream. Viaducts, bridges, tunnels, dams, cuttings, embankments, etc., would make this portion one of the most costly pieces of railway construction in the whole empire, but as a means of establishing a commercial connection with the rich province of Sze-chuen, it cannot be avoided. The length of the stretch, Patung—Wushan, is somewhat more than 37 miles.

When the latter town is reached, however, the greatest difficulty in the construction of the Yangtse railway is overcome. The valley becomes more and more open, richer, more fruitful, and more populous. The cliffs advancing up to the river-bank in the 25-mile stretch from Wushan-hien to Kui-chau-fu are inconsiderable both in length and height, could for the most part be easily avoided, or, as in the case of the Fung-seang gorge, 3 miles long, east of Kuichau, the line could be laid without any considerable difficulty on the ground above the rocks.

Between Kuichau-fu and Chungking-fu no noteworthy difficulties occur. The total distance is 310 miles.

The bridging of the Kialing-kiang, or Siao-ho, at Chungking, which Dr. Kreitner, in the absence of definite information with regard to this part of the river, estimates to have a breadth of at least 800 feet, would be the next costly work on this line. Between Chungking and Chengtu-fu Dr. Kreitner's proposed line deviates from the regular trade route, in order to avoid the highly diversified country followed by the latter.

Running parallel to the North China and the Yangtse valley railways, Dr. Kreitner conceived a third east-west trunk line in the basin of the Si-kiang, which he called the South China Railway. This line, he believed, ought to start from the bank of the Si-kiang, at the north-west end of the city of Canton, and then run first north-westwards to a point opposite the south point of the Balcher island, where the Pearl river would be most easily crossed by means of three bridges. From Fushan, 3½ miles from Canton, it would run first in a straight line to Hsinam, or, in the Canton dialect, Sainam, east of which town a narrow canal would have to be bridged. The line would then change from a north-westerly to a westerly direction, running in the latter direction to Samshui-hien (19½ miles beyond Fushan), at the confluence of the Pei-kiang. This river would then be bridged at a point where two islands lie in the stream. The line would then go up the right bank of the Si-kiang, crossing eight canals before reaching the lower end of the Shaohing gorge, at the upper end of which stands Chao-ching-fu, 31 miles above Samshui. No difficulties are mentioned by Dr. Kreitner in connection with the Shaohing gorge, and the first costly work that would have to be undertaken on this line above Samshui would be the bridging of the Lishui, which enters the Si-kiang at Fengchuan-hien, 117 miles above Samshui. The breadth of this river is estimated at about 200 yards. As far as Wuchau-fu, 44 miles further on, the work of construction would be very easy, but on the west side of this town the bridging of the Fu-kiang, or Kwei-kiang, the costliest work of the kind on the whole of the South China railway, would have to be undertaken. The river is here from 1050 to 1100 feet wide, and 6½ feet deep, and has firm banks.

The route up the lower Pak-ho, instead of that up the Si-kiang, is selected by Dr. Kreitner partly because he considers it desirable for China for defensive reasons not to lay the railway too near the frontier of Tongking, and partly on account of the difficulties presented by this latter route, in consequence of the great differences in altitude within short distances, in the way of continuing the line into Yunnan,

in the neighbourhood of Kwangnan-fu. Apart from these circumstances, the richer southern valley of Kwangsi would be the better route to follow.

The further details of Dr. Kreitner's route need hardly be considered, however. Where it runs through explored country, the difficulties, on his own showing, are very considerable, and from Tunglan-chau, on the Hungshui-kiang, in about 107° E. to the Yunnan frontier, it runs through country about which all that is known is that it is wild, mountainous, without considerable towns, and very thinly peopled. It is generally admitted that, notwithstanding the differences in altitude between the Kwangsi valleys and the Yunnan plateau, illustrated in one of the sections accompanying our map (Kaihua to Pose*), the valley of the Yu-kiang, or left branch of the Si-kiang, is that which would afford the best approach to the latter province. The top of the plateau once gained, no great difficulties remain to be encountered on the way to Yunnan-fu. The route is well known from the travels of Colquhoun, Bourne, and Rocher.

Eventually this line would be continued to Tali-fu, the chief town of western Yunnan. Varied as the surface of this region is, the railway, keeping for the most part to the same route as the present commercial highway (a section of which is given from Baber on our map), would be carried to its goal without trouble. It would run throughout near the water-parting between the Yangtse and the Mekong and Songkoi, through a not very populous highland region, not ill-supplied with wood for building and fuel, and provided with adequate coal-supplies for the needs of the railway. Coalfields, as well as copper-mines, occur between Chuhsiung-fu and Chenan-chau† Its total length would be about 240 miles.

Among the difficulties to be surmounted are the Chiopan-shan pass (6070 feet), just beyond Lufeng-hien, 56½ miles from Yunnan-fu, involving a gradient of 1 : 80; the somewhat more arduous ascent of the next height, Menghsiapu, 7 miles, on the east side of Kwantong, where, coming from the east, an altitude of 600 feet has to be surmounted in a distance of about 3¾ miles (average gradients of 1 : 75 or 1 : 80), and a descent on the other side of 440 feet to Kwantong, at first with a gradient of 1 : 75, afterwards one of 1 : 100; somewhat steep serpentine ascents and descents (up to 1 : 65) in the 51 miles between Chunghuatung and Chaochau, on the borders of the plain to the south of the Erh-hai, 6 miles from Hsiakwan, and 25 from Tali-fu.

Two connecting lines between the Yangtse and Si-kiang valleys are considered by Dr. Kreitner. He leaves altogether out of account the possibility of such a connection across the Cheling pass to Canton, probably in consequence of the adverse views of this route expressed by Richthofen.‡ In spite of the difficulties which Richthofen indicates, a concession for a railway following this route has been obtained by an American company, but the fact was made known too recently for the insertion of the line on our map.

Dr. Kreitner's upper connecting-line between the Yangtse and Si-kiang valleys is that which he calls the Siang-kiang railway, following the valleys of the Siang-kiang and Kwei-kiang.

On account of the difficulty of bridging the Yangtse-kiang, this line would have to start at Wuchang-fu, and connect with the Yangtse line at Hankau by means of a train-ferry, such as that also suggested above for the Chingkiang crossing.

On the choice of this route rather than that of a more direct route to Wuchau-fu,

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* Based on data furnished in the "Report of a Journey in South-Western China," by F. S. A. Bourne (China, No. 1, 1880 [C. 5371]), before p. 69.

† At Chingyuanshan.

‡ Letter I., p. 2, note. See the passage quoted in *Proc. R.G.S.*, 1880, p. 156.

up the valley of the Tan-ho on the left bank, Dr. Kreitner remarks that this might prove, on examination, to be the best route. He did not know the province of Kwangsi personally, but was led to regard the Kweilin route as the most likely from the fact that the existence of the canal connection of that river with the Siang would seem to indicate that the tendency is for trade to follow that direction.

The lower connecting-line between the Yangtse and Si-kiang valleys is the Kiukiang—Canton line through Kiangsi (up the Kan, across the Tayaling mountains, and down the left bank of the Pei-kiang), the total length of which would be 565 miles.

The name of the Tea District Railway was given by Dr. Kreitner to a line suggested by him between the treaty ports of Kiukiang and Fuchau, in order to bring the tea, tobacco, hemp, and paper districts of northern and eastern Kiangsi and western Fokien into rapid communication with the treaty ports above mentioned.

Starting from Kiukiang, the line first passes round the base of the northern and eastern spurs of the Lushan to the west side of the Poyang lake, and along this to the provincial capital of Nanchang-fu, but then, instead of following the route of the projected telegraph line by Fuchau (in Kiangsi) and Kienchang to Shaowu, it strikes eastwards to reach the tea-districts of eastern Kiangsi. The difficulties of crossing the frontier mountains on this route across the Maling (in the pass of Chungan between Chienshan-hien and Shaowu) are not greater than those encountered in passing the Yünling on the other (telegraph) route between Kienchang and Shaowu. From this place the line runs through the black tea districts of Fokien and in the valley of the Min to Fuchau, this valley being reached by a considerable serpentine curve to the north-east and south-east on the east side of the frontier pass. In the Min valley the line would first run on the right bank, and then, after crossing by a bridge above Yenping, on the left. For the direct shipment of the tea, it would be well to carry the line right on to the arsenal of Fuchau (Pagoda anchorage). The total length of the line would be 515 miles.

Richthofen has pointed out that another easy connection between the province of Kiangsi and the sea would be by means of a railway from Ningpo, following what he calls the Lanki valley *—that is, the line of valleys running nearly east and west across the middle of the province of Chekiang, formed by the valleys of two headwaters of the Tsientang-kiang, the Kinhwa and Kichau streams, meeting mouth to mouth, like the valleys of the San Joaquin and Sacramento in California. Crossing the water-parting separating Chekiang from Kiangsi, the line would descend the valley of the Kin-kiang.

In eastern Kwangtung, the laying of a line from Kaulun to Canton is urged in the interests of Hong-kong. On this route the only difficulties could consist in the bridging of the numerous streams of the delta of the province.

To reach the Si-kiang valley from the south, concessions have been obtained by the French for a line from Pakhoi to Nanning, and for the continuation to the same place of the line already begun from Hanoi by Langson to the valley of the Tso-kiang, or right headwater of the Si-kiang. The water-parting to be crossed on this route is probably not less than 3000 feet.†

The proposed French line from Laokai on the Red river (Song koi) to Yunnan-fu by Mengtse would have to surmount the same obstacle as that which would be met on the proposed line between Kwangsi (Yu-kiang valley) and Yunnan-fu, namely, the ascent of an altitude of about 6000 feet within a comparatively short distance. See the section from Manhao to Mengtse, reproduced from that in the

* Letter IV., p. 11.

† Agassiz in *Proc. R.G.S.*, 1891, p. 251.

First Decennial Report of the Imperial Maritime Customs, China, compiled by Chr. Jensen of the Imperial Chinese Telegraphs, on the sheet accompanying our map.

In this country no Chinese railway projects have been more frequently and more keenly discussed than those for connecting China with Burma, but the only project of this nature that does not appear destined to encounter insuperable difficulties from the nature of the ground to be crossed is that first proposed by Mr. Colquhoun,* and described to this Society by Mr. Holt Hallett.† Starting from Maulmain, this line, after crossing two passes respectively about 1600 and 2300 feet high, would reach Raheng, in the valley of the Mehping (right headstream of the Menam), and then, proceeding northwards across a few passes all under 2000 feet in height, would reach the valley of the Mekong at Chieng-sen (in about 20° 15′ N.), and then proceed up this valley to Sumao, in southern Yunnan. To this route Mr. Colquhoun still adheres,‡ while he states that the continuation of the line already made from Mandalay to Kunlon ferry would meet in China with obstacles of a very serious character in the shape of mountain barriers running north and south.§

The further continuation of the proposed line to Sumao is among the projects discussed by Dr. Kreitner, who admitted that, while the difficulties of the route between that place and Yunnan-fu are great enough, they are nevertheless not so great as those which would have to be encountered in any attempt to connect China and Burma by more westerly routes—projects which must be dismissed as quite impracticable.

The first part of the route Sumao—Puerh, 28 miles long, traverses a much-cut hill country from north to south. On the west section, Puerh—Papien, on the Papien-ho, 31 miles, the extremely difficult intervening watershed, a steep-sided forest-clad mountain range, would have to be crossed. From this point the route would follow a tributary of the Papien-ho down to that stream, which at Papien is about 90 yards wide.

From Papien, running east-north-east to Yuankiang-chau, a distance of 70 kilometres, the line would ascend the rugged plateau of Tongkwan, and from it descend to a side valley (the river 80 feet wide, 3 feet deep). Then, continuing eastwards by Chang-luping and Talang-chau to Tienso, it would cross a mountainous country cut up by the valleys of several mountain torrents (the relative differences in altitude amounting to about 1000 feet). Between Tienso and Yuan-king the water-parting between the Papien-ho and Yuan-kiang (Songkoi), with a relative altitude of 3300 feet, has to be crossed—certainly no easy matter, though the exact route remains to be determined by a detailed survey. The remainder of the route is not without difficulties, though of a minor order compared with those already mentioned. The total length of the line from Sumao to Yunnan-fu would be 288 miles (see the section from Bourne, *ubi supra*, before p. 21, on the sheet accompanying our map).

Our map shows the ordinary trade-routes between Yunnan-fu and the Yangtse, but so great are the difficulties along all these routes, that Mr. Hosie, who has traversed them all, is forced to exclaim that if foreigners ever found their way into Sze-chuen by any one of them, he should be delighted and astonished in about equal proportions.‖ Two of these routes are partially illustrated in our section-sheet—the westernmost route by the Laowatan-Yunnan section (from 'Foreign Office Report,' Miscel. Series, No. 458, p. 53) and the Kweiyang-Chungking section (based on the data furnished by Bourne, before p. 79).

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* 'Across Chryse,' vol. ii. p. 233.

† *Proc. R.G.S.*, 1886, pp. 1–16.

‡ 'China in Transformation,' pp. 113, 119, 124.

§ Ibid., p. 114.

‖ *Proc. R.G.S.*, 1886, p. 383.

With this view Dr. Kreitner was so far agreed that he considered that many years must elapse before the construction of a line from Chengtu-fu to Yunnan-fu could be thought of. One route, however, for such a line is discussed by him, much the same as that shown in the Laowatan-Yunnan section on our sheet of sections.

The narrow rugged valley of the Yangtse above Sui-fu is, he states, altogether unsuited for the laying of a railway. The river would accordingly have to be crossed either at or above Sui-fu, preferably at Anpien, 21½ miles above Sui-fu.

At Tangaitung a serious rise begins leading up to the high plateau of Chasbang, which is crossed about Chaotung-fu. After crossing this plateau, it descends 2300 feet into the valley of the Niulan-kiang and reaches Chiang-ti. Here the Niulan-kiang, with a breadth of 100 miles, would have to be bridged. If possible, the route would then be taken up this somewhat wild and romantic valley, or across the land on its left bank in a bend to the east and south, then up other minor valleys, till with a short but steep ascent it reached the high plateau of Lungwan-miao, which it would then traverse in a southerly direction to Tungchuan-fu. It would then ascend the Tungchuan-fu river (a tributary of the Yangtse), until by another somewhat steep gradient it ascended to the plateau of Kuangtou-pu. Thence it would run over very broken ground with a sparse population till it entered on a more productive valley at Hsuentien-chau. It would then ascend the Tangtsu, cross another hill, and then, after Yanglin, accomplish the last 34 miles to Yunnan-fu across an easily traversed flat surface. The total length of the line would be about 620 miles. Equally or even more difficult is the route from Tali-fu to the fertile basin of Sze-chuen. Our section-sheet gives two sections (from Baber's 'Travels and Researches in South-Western China') of the route followed by Baber in making this journey (through the fertile valley of Kien-chang).

THE MONTHLY RECORD.

EUROPE.

Regional Geology of England.—The Cambridge University Press has recently published 'A Handbook to the Geology of Cambridgeshire,' * which presents some novel and important features. It is, we believe, the first English book in which Prof. W. M. Davis' system of the classification of rivers has been fully adopted. The introductory description of the physical geography of the region has by this means been rendered concise and systematic. While Cambridgeshire, viewed superficially, is one of the most featureless of English counties, the study of the origin of the chalk escarpment and the fenland invests its geography with a real significance, which is intensified by the full consideration of the various geological formations and their economic value. The book is written in a clear and systematic style, with abundant references to original authorities. No geological map is given, as one sheet of the new 4-miles-to-an-inch colour-printed map of the Geological Survey includes the whole district, and can be purchased at a moderate price.

Dr. Thoroddsen on the History of Iceland.—The first volume of the translation of Dr. Thoroddsen's work on the history of Icelandic geography was noticed in the *Journal*, vol. xi., 1898, p. 173; it has now been followed by a second, dealing with the history of Iceland from the beginning of the seventeenth

* 'A Handbook to the Geology of Cambridgeshire, for the Use of Students.' By F. R. Cowper Reed. Cambridge: at the University Press. 1897.

to the middle of the eighteenth century. The fuller title now given * is more descriptive of the work, which, while geographical fundamentally, is by no means exclusively devoted to subjects that can be brought under the name of geography by the most generous stretching of its definition. The material here made available is for the most part new, inasmuch as it is published for the first time from original manuscripts preserved in various places in Iceland and Copenhagen. The volume begins with two fascinating chapters on Icelandic witchcraft and magic, then goes on to consider the views on scientific matters entertained in Iceland during the seventeenth century, with numerous biographical notices. About two-thirds of the space is taken up with detailed accounts, often containing long and interesting quotations of the early descriptions of Iceland, divided into Icelandic, Scandinavian, and other writings of the seventeenth century. The foreign descriptions of the island were too often "travellers' tales" of the most exciting kind; no wonder, natural or supernatural, was too strange to be planted in Iceland; and it is a little humiliating to find these stories, reflexes of the fancies of the fifteenth century, gravely repeated in works published in London as late as 1726. The first survey of Iceland is fully described. Prior to 1721 there existed only rough charts of principal harbours, but in that year Magnus Arason Thorchillius, himself an Icelander, was sent by the Danish government to map the island and its coasts, the Danish authorities having a very humble idea of the size of Iceland and of the cost and difficulty of the work. He laboured at his prodigious task for seven years, when he was accidentally drowned. The work, however, was continued. The first half of the eighteenth century also saw the completion of a number of remarkable local descriptions of parts of Iceland, written mainly by the clergy of the various parishes, and some of them were so well done as to retain their practical value to the present day. An account of Dr. Thoroddsen's many years' exploration in Iceland, written by himself for this *Journal*, will shortly be published, with a new map of the country.

ASIA.

Dr. Futterer's Journey across Asia.—Dr. Karl Futterer, of Karlsruhe, whose journey to Kashgar was noticed in the *Journal* for June (vol. xi., 1898, p. 664), writes from Liang-chou, in the extreme east of the Chinese province of Kansu, on June 25, with further particulars of his journey across Asia. His expedition left Kashgar on February 24, 1898, and followed the route eastward through Turfan to Khami. There a camel-caravan was got together, and the journey continued in a straight line south-eastwards to Su-chou, across the mountainous part of the Gobi desert. This gave opportunities for many very interesting observations of the geological structure of the Gobi, and of desert phenomena, which throw light upon the origin of deserts. In the low-lying parts of the Gobi, at the northern and southern extremities of this section of the journey, great heat was experienced, the daily maximum of the shade temperature approaching 90° Fahr.; but on entering the higher ground in the middle, the air became much cooler, and at night the temperature fell to 14° Fahr., and on the night of May 17 a heavy snowstorm came from the north-east. The range in the temperature of the ground from the warmth during the day to the cold at night, in no less than thirteen instances during the month of May, exceeded 54° Fahr., and

* Th. Thoroddsen, 'Geschichte der Isländischen Geographie. Vorstellungen von Island und seiner Natur und Untersuchungen darüber in alter und neuer Zeit.' Autorisierte Uebersetzung von August Gebhardt. Zweiter Band. Leipzig: B. G. Teubner. 1898.

on one occasion, in the southern part of the desert, it was more than 76° Fahr. Suchou was reached in thirty days from Khami, and Dr. Futterer entered Liang-chou on June 23. His plan for further work was to proceed southward through Si-ning to Koko-nor, and thence to explore the almost unknown upper valley of the Hwang-ho. The expedition will probably return to Europe early in the spring of next year.

Austrian Expedition to Southern Arabia.—The Vienna Imperial Academy of Sciences has decided on the despatch of an expedition to Southern Arabia, with a special view to the exploration of the extensive ruins in the Hadramut. Count Karl Landsberg, the well-known Swedish Arabist, who, during a long residence in the South Arabian coastlands, was able to establish friendly relations with certain of the sheikhs of the interior, will assume the leadership of the expedition in association with Dr. D. H. Müller, professor of Semitic languages at the University of Vienna. The other members of the expedition will be Dr. Alfred Zahn, Prof. Oskar Simony (son of the deceased Austrian geographer), and Dr. Franz Kossmat, of the staff of the Imperial Institute of Geology, a former pupil of Suess and Penck. The personal exertions of King Oscar of Sweden have enabled the Academy to charter in Stockholm the steamer *Gottfried*, a vessel of 600 to 700 tons, equipped with all modern appliances, for the objects of the journey. It sailed from Stockholm on September 28, and was to proceed to Aden *viâ* Hull, Gibraltar, and Suez. It is thought that the expedition will last from four to six months. Inasmuch as the district in question, once one of the most important emporia of the trade of the world, has been little visited by European travellers, valuable results may be hoped for from the point of view of the ancient history of civilization, no less than from that of geographical and geological science.

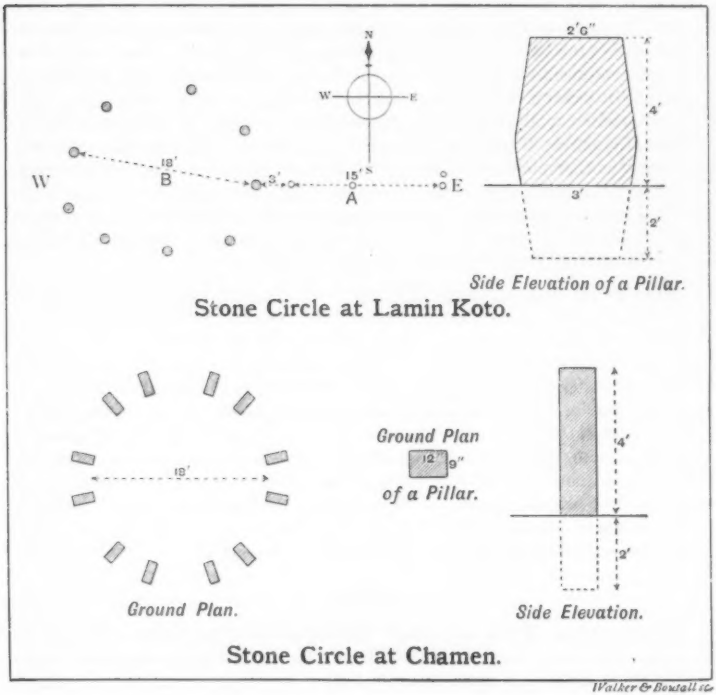
Routes in Jammu and Kashmir.—Under this title, Major-General de Bourbel, late chief engineer of the Jammu and Kashmir state, has recently published a work which should be of much practical use to travellers in that region (Calcutta: Thacker, Spink & Co.). It gives statistics, in tabulated form, of a large number of routes in Kashmir and Jammu, mentioning the length of the stages, general nature of the route, chief physical features passed, and the availability or otherwise of supplies, grazing, transport, etc. Although in the main merely a compilation from the works and maps of other travellers, the author has drawn on his personal knowledge for some part of the information, and for the means of checking that obtained elsewhere. The routes are arranged in five groups, radiating from the centres Jammu, Panch, Srinagar, Gilgit, and Leh, the chief towns of some of the most important provinces in the Maharaja's dominions.

AFRICA.

Geographical Work of Major Macdonald's Expedition.—Writing in July last from Save (north of Mount Elgon), on the eve of his departure northwards, Major Macdonald gives us some further information (cf. *Journal*, vol. xi. p. 548) as to the geographical work done by members of his expedition. The principal result so far has been the discovery that the Lake Ibrahim marked on our maps as an expansion of the Victoria Nile does not exist, and that Lake Kioja extends much further eastward than has been supposed. The broad lower reaches of the Sesiwa are the only feature that could have been taken for the former lake, and it is possible that the native use of the word "Nyanza," as applied to the Nile, may account for its previous insertion. Lake Kioja (explored by Captains Kirkpatrick and McLoughlin) extends between 50 and 60 miles east, with an average width of about 10 miles, though there are long extensions in the form of bays, one

of which stretches 20 miles to the south-east. There are regular lake-dwellers living both in pile houses and on islands. Major Macdonald's route from Mumia's to Save led west of Elgon, and mainly west of Hobley's route. This has enabled him to ascertain the nature of the drainage from Elgon towards the Nile, and to map Lake Salisbury and the small lakes near it more accurately than had been hitherto done. We are not told, however, whether or not these are drained towards Lake Kioja, as has been hitherto supposed.

Sacred Stones in West Africa.—Captain J. W. Maxwell Carroll sends us some details, accompanied by sketches and a photograph, respecting the interesting discovery of ancient stone circles, etc., made by him in the neighbourhood of Lamin Koto, on the right bank of the upper Gambia. Those at that place are in particularly good preservation, and are also still looked upon with respect by the



natives, whilst elsewhere they are, as a rule, disregarded. Prayers are offered in their vicinity on feast days during Ramadan by the Almame, or high priest, and it is believed that all prayers offered up within the enclosure formed by the stones are granted. In the accompanying diagram, A denotes the spot occupied by the priest, the people standing at B. The origin of the pillars is quite unknown, and the present inhabitants have not the means either of transporting or working on them. The diameter of the circle is 18 feet, and all the measurements are multiples of 3, while, curiously enough, 1 foot may be taken almost exactly as the unit.

In the pagan country of Niani Bantang the stones were quite unheeded, and were only discovered by accident hidden in the long grass and brush. At Chamen the pillars were arranged in pairs instead of singly, and their section was rectangular, not circular; but the diameter of the circle and the height of the stones (6 feet) remained constant. At Palellan a stone circle was found in use, with the help

SACRED STONES ON THE GAMBIA.

of poles, for stacking grain, whilst isolated stones seen elsewhere seemed to show that some had been removed. On a hill commanding a magnificent view of the surrounding country, a huge rectangular stone, 12 feet by 4, was found. Its height was 6 feet at one end and 4 at the other, and its shape suggested that it had been used as a sacrificial altar.

M. Gentil's Exploration of the Shari.—A connected narrative of M. Gentil's expedition, respecting which we have already given some details, appears in the September number of the *Bulletin de l'Afrique Française*. As is well known, the French explorer ascended the Mobangi to its most northerly bend, and then struck northwards up the Kemo, a small northern tributary. Crossing over to the Tomi, also a feeder of the Mobangi, M. Gentil ascended this stream to the limit of navigation, where the post of Krebeje was established. After some negotiation with the Manjias, the warlike tribe which opposed M. Maistre's expedition, he was able (September 18, 1896) to reach the Nana, belonging to the Shari basin, and sent on MM. Hunzbuchler and Prins to reconnoitre its course. Below a series of rapids discovered by them, which extended over 5 miles, with a total fall of 300 feet, a station was founded, and the *Léon Blot*, the steamer intended for the navigation of the Shari, was successfully launched early in 1897. At the junction of the Nana with the Gribingi some delay occurred, owing to the suspicious attitude of the Senussi Mussulmans, but these were in time propitiated, and in August, 1897, the voyage was resumed. The Gribingi was at first so

narrow that the overhanging branches impeded navigation, but it soon widened to over 60 yards, and the steamer proceeded at a rapid pace. In lat. 8° 30′ three rapids were met with, but they are easily passed at high water. The country is well peopled, though the immediate banks of the stream are uninhabited, owing to the inundations. On August 20 the expedition reached a river 200 yards wide, known to the natives as Bamingi, which is the principal branch of the Shari. According to a map given with the narrative, it was this river, and not the Gribingi, which was reached by Dybowski further to the east. The confluence of the Gribingi is in 8° 35′, and in 8° 42′ the Shari is joined on the right bank by an important stream called Bangorran. On September 3 the river became encumbered with islands, and attained a width of over 4000 yards, and on the same day the territory of the Niellims, a tribe subject to Bagirmi, was reached. The country was well cultivated, but was only then recovering from the effects of Rabah's passage five years before. M. Gentil received an invitation from the Sultan of Bagirmi to visit him at Massenya, which it seems has again taken its place as the capital; it still shows the results of its destruction by the troops of Wadai in 1870, but its houses are being rebuilt. M. Gentil arrived by the Bahr-el Guir, which is the Ba Bachikam of Nachtigal; this is spoken of as an affluent of the Shari, and it is not stated whether it is a divergent branch of the main river as hitherto supposed and as shown on the map. The Bahr es Salamat, or its continuation west of Lake Iro, is shown on the latter as joining the main Shari—in about 10° 10′ N.—and not the Ba Bachikam, as thought by Nachtigal. Quitting Bagirmi, Rabah's dominions were soon reached, and the mouth of the Logone, a magnificent stream with a strong current, was passed. Below this the Shari divides into three important branches. Only a short stay at Lake Chad could be made, on account of the enmity of Rabah. On the return to Bagirmi, M. Prins was left at Massenya as French resident, while two envoys from the sultan accompanied M. Gentil to France.

Major Marchand's Expedition.—Some details respecting the inception and early stages of this expedition were given in the *Journal* for February last (vol. xi. p. 170). From Tambura, where a French post had been established by M. Liotard early in 1896, Major Marchand and his officers appear to have proceeded northwards by various routes, the expedition being, however, again united at Fort Desaix, a post established at the junction of the Sue or Jur with the Wau. Other posts had been founded *en route* on the upper Sue as well as on the Wau and Tonj. The boats which had been transported with endless trouble from the Mobangi were launched on the Sue, and the last part of the route was performed by water, *viâ* the old Egyptian river-port Meshra-er-Rek. For details respecting the voyage to Fashoda, the publication of Major Marchand's report must, however, be awaited. The chief authority on the region of the Bahr-el-Ghazal traversed by the French expedition is, of course, Dr. Junker, who in the second and third volumes of his 'Travels in Africa' described his extensive journeys in that region between 1879 and 1886. A condensed account of those journeys appeared in the *R.G.S. Proceedings* for 1887, accompanied by a map. The complete results of his surveys were published as supplementary numbers of *Petermanns Mitteilungen* (Nos. 92, 93, 1889), the maps being drawn on the large scale of 1: 750,000. Information respecting the Bahr-el-Ghazal province under Egyptian rule is also to be found in Schweinfurth's 'Heart of Africa,' Gessi's 'Seven Years in the Soudan,' and in a paper describing Lupton Bey's explorations, read before the R.G.S. in 1884 (*Proceedings*, 1884, p. 245). A useful sketch of the history of the Egyptian Sudan is given by Herr Frobenius in his work 'Die Heiden-Neger des ägyptischen Sudan' (1893). It may be observed that Fashoda was an Egyptian post so far back as

1867, and that it remained throughout independent of the Bahr-el-Ghazal province, being the residence of a mudir directly subordinate to the Government at Khartum.

New Determination of the Height of Mount Cameroons.—In the latest issue of the *Mittheilungen aus den Deutschen Schutzgebieten*, Baron von Danckelmann has a short note on the recent determination of the height of Mount Cameroons by Dr. Preuss, who ascended the mountain in March, 1898. The determination was made by boiling-point thermometer, and as simultaneous observations of atmospheric pressure were carried out at sea-level at the government station at the Cameroons, while the corrections for the thermometer employed were known with some accuracy, Baron von Danckelmann considers that the figure obtained merits greater confidence than those of previous observers, which, he says, rest on no secure basis. Dr. Preuss considers the Fako peak to be the highest summit of the mountain, and his altitude for this is 13,370 feet, as compared with 13,760 of the English Admiralty chart (derived from Captain Owen's surveys), 13,129 of Burton, and 13,508 of Johnston. The differences may, Dr. von Danckelmann thinks, be partially accounted for by the fact that all the measurements do not refer to the same summit, some apparently being made for the Victoria peak, which, according to Burton, is somewhat lower than the Albert peak, this seeming to correspond with the "Fako" of Dr. Preuss. Considering the methods employed, however, the divergences can hardly be considered excessive.

Domestication of the African Elephant.—M. P. Bourdarie, who has lately returned from a government mission to the French Congo, is a firm believer in the possibility of the domestication of the African elephant, and an advocate of experiments in that direction. Writing to the *Politique Coloniale* of October 8, he calls attention to the fact that an African elephant has during the past year been regularly employed at the Fernan Vaz mission for purposes of transport. It was captured by the Pahuins and purchased by Père Bichet, who succeeded in training it without the aid of Indian elephants. Although only four years old, it makes the journey from the mission to the forest—a distance of 2 miles—eight times a day, and transports loads of 1800 to over 2000 lbs. by the means of a wheeled vehicle. It finds its own food in the jungle, and can be driven by two native boys. When proceeding to the Congo during the summer, M. Bourdarie took with him a large number of Wardian cases of india-rubber and gutta-percha plants (Isonandras, Heveas, and Castilloas) for introduction into the French colony.

AMERICA.

Sir Martin Conway in the Andes.—The *Daily Chronicle* publishes a telegram from La Paz, announcing the results of Sir Martin Conway's attempted ascent of Mount Sorata. A camp was established at a height of 20,000 feet in September, but bad weather necessitated its temporary abandonment. On October 9 a return was made to the camp, and on the 10th the party proceeded up an excessively steep slope of rotten snow, until a point was reached just below the summit, further progress being then stopped by an impassable crevasse. The highest point reached was, Sir Martin Conway thinks, between 23,000 and 24,000 feet. Should this prove the case, the mountain will be considerably higher than has been supposed, and the old idea that it is the highest summit of the Andes may very possibly be justified. During the ascent the thermometer sank to 2° Fahr., or 30° of frost, and both the guides suffered from frost-bite. A second attempt to reach the actual summit proved equally unsuccessful.

AUSTRALASIA AND POLYNESIA.

Islands and Coral Reefs in the Fiji Group.—The *American Journal of Science* (vol. v. No. 26) contains a series of extracts from a letter addressed by Dr.

Alexander Agassiz to E. S. Dana, dated from Suva, in the Fiji islands, and giving a preliminary account of a six-weeks cruise amongst the islands on board the s.s. *Yaralla*, a twin-screw steamer chartered from the Australasian United Steam Navigation Company. The *Yaralla* was fully equipped with apparatus for deep-sea investigation, and boring machinery was landed and set up at Wailangalala. From the geological examination of the whole region, Dr. Agassiz is now of opinion that boring through the coral rock of this region can give no information on the main question of coral formation. He says, "I came to Fiji under the impression that we were to visit a characteristic area of subsidence; for according to Dana and Darwin there is no coral reef region in which it is a simpler matter to follow the various steps of the subsidence which has taken place here. . . . My surprise was great, therefore, to find within a mile from Suva an elevated reef about 50 feet thick and 120 feet above the level of the sea, the base of the reef being underlaid by what is locally called soapstone, probably a kind of stratified volcanic mud." Traces of elevation in different localities are remarked on; and Dr. Agassiz proceeds, "All this plainly shows that the southern part of Viti Levu and as far south as Vatu Leile, and the whole length of the Windward islands of the Fiji group from Ngele Levu on the north to Ongea on the south, have been subject to an elevation of at least 800 feet; as there is abundant proof that a great part of the thickness of the elevated reef has been eroded to reduce it in certain localities to the level of the sea or to leave at others bluffs and islands or islets, the occurrence of which we have traced at so many points. . . . I am inclined to think that the corals of to-day have actually played no part in the shaping of the circular or irregular atolls scattered among the Fiji islands; furthermore, that they have had nothing to do in our time with the building up of the barrier reefs surrounding, either wholly or in part, some of the islands. I also believe that their modifying influence has been entirely limited in the present epoch to the formation of fringing reefs, and that the recent corals living upon the reefs either of the atolls or of the barriers form only a crust of very moderate thickness upon the underlying base. The base may be either a flat of an eroded elevated reef or of a similar substructure of volcanic rocks, the nature of that base depending absolutely upon its character when elevated in a former period to a greater height than it now occupies." Dr. Agassiz is unable to state the age of the elevated reef of the Fiji, or to decide whether the date of elevation coincided with that of northern Queensland. He discusses observations on the formation of atolls on the eroded summits of extinct craters, and points out that the great depth of the lagoons of some of the atolls can no longer be considered as a proof of the theory of subsidence. The general conclusion is to emphasize the fact that it is impossible to assign any one factor as the single cause for the formation of the many different kinds of atolls and barrier-reef islands to be found in the Fiji group.

British Annexation in the Pacific.—The British Protectorate over the Southern Solomon Islands has this year been extended by the hoisting of the British flag over the islands of the Santa Cruz and other small groups to the north of the New Hebrides. This was done by H.M.S. *Mohawk*, which left Sydney for that purpose in April last. The Santa Cruz group is celebrated in history as the scene of the death of the Spanish navigator Mendaña, and of the disastrous termination of La Pérouse's expedition. Some account was given in the *Journal of the R.G.S.* for 1872, by Admiral (then Lieut.) A. H. Markham, the paper being accompanied by a map. During the cruise of the *Mohawk*, a volcanic peak was observed to be partially active.

POLAR REGIONS.

Antarctic Icebergs and Shipping Routes.—The following letter, dated September 6, 1898, on this subject from Mr. H. C. Russell, C.M.G., the government astronomer of New South Wales, has been forwarded by the secretary of the Shipmasters' Society: "In answer to your question, 'How is it that the Indian Ocean field of icebergs is confined between the meridian 40° and 90° E., and between the parallels 40° and 50° S.?' I may say that I think the number of ships passing through that region in the so-called safety track tends to make the number of *reported* icebergs greater than it is in regions north and south of it, where few vessels pass. And also in part it is probably due to the antarctic current, which sets northwards about the Crozets, and the return warm current, which sets to south near Kerguelen, and it would appear that this limitation of the field is only recent. For my first paper shows them from 20° E. to 60° E., and Towson places them 50° W. to 90° E. I think these reports are too condensed. We want the icebergs for each month and each year plotted each on a separate chart, with currents, winds, and weather shown, and then a careful study of the whole would, I feel sure, help us very materially in grasping the whole difficulty of the *iceberg*; and my pet scheme, were the money available, would be to send a party of competent observers in a suitable steamer to go amongst the icebergs in latitudes used for commerce, and study them for say six or eight months."

Captain Sverdrup's Polar Expedition.—From a correspondent on board the *Fram*, the *Times* has received details (despatched from Godhavn on July 30) regarding the voyage across the Atlantic and up the west coast of Greenland to that point. During the passage across the Atlantic a continuous head wind was experienced, which drove the *Fram* up under the Færoes and Iceland. Stormy weather was also encountered, and the ship rolled violently. On July 19, in the neighbourhood of Cape Farewell, the *Fram* got into the ice, which this summer was brought down in great masses by the arctic current, and it was two days before the ship was clear. On the west coast of Greenland the effect of the current reached an unusually high latitude, and the prediction of a favourable season for the navigation of Davis strait was not verified. The approach to Sukkertoppen was completely blocked by ice, but the ship succeeded in calling at Egedesminde, where thirty-six dogs were taken on board. More were to be embarked at Godhavn and Upernivik, whence the course was to be shaped for Cape York. Meteorological and other observations were commenced early on the voyage, and several "floaters," or receptacles for messages, had been thrown overboard before reaching the neighbourhood of Cape Farewell.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Distribution of Oceans and Continents.—At the Bristol meeting of the British Association, Dr. J. W. Gregory read a paper on the theories of the distribution of the oceans and continents on the Earth's surface. He pointed out that the main object of geomorphology is to explain the existing distribution of land and water on the globe. A remarkable series of coincidences in the form and arrangement of the land masses suggests that the distribution has been determined by some general principle and not by local accidents. The three most striking features that require explanation are the antipodal position of oceans and continents, the triangular shape of the geographical units, and the excess of water in the southern hemisphere. Attempts to explain this arrangement have been made deductively from general physical considerations, by Elié de Beaumont, Lowthian Green, and G. H. Darwin; and directly from the evidence of stratigraphical geology, by

Suess, Lapworth, and Michel-Levy. Taus Elié de Beaumont regarded the form of the continents as determined by the mountain chains, which he correlated into a regular geometrical network; while Lapworth regarded the distribution of land and water as due to a series of great Earth-folds, the arches forming the continents and the troughs forming the ocean basins. Suess has treated the subject synthetically; he has shown that the structure of the world can be explained by subsidences in the crust when subterranean support is removed by the shrinkage of the internal nucleus, and by the movements of elevation which produce the chains of fold-mountains. Suess's view explains the structure of the continents and ocean basins, but not their arrangement. To settle this problem fuller knowledge is needed as to the distribution of land and water in past times. Neumayer's attempt to settle this question for the Jurassic was premature, and his conclusions are untenable. We are thus still dependent upon the deductive systems for suggestions as to the most profitable lines of research. Elié de Beaumont's famous scheme attached undue importance to linear symmetry, and was too artificial. It led, however, to the tetrahedral theory of Lowthian Green, which regards the world, not as shaped like a simple tetrahedron, but as a spheroid slightly flattened on four faces. Such flattenings occur on hollow spherical shells when they are deformed by uniformly distributed external pressure. The oceans would occupy the four depressions thus produced, and the land masses occur at the angles and along the edges. The existing geographical arrangement is in general agreement with this scheme; for, as the tetrahedron is hemihedral, the assumption that the lithosphere is tetrahedral explains the antipodal position of land and water, the excess of water in the southern hemisphere, and the southward tapering of the land masses. The main lines of the existing system of fold-mountains have a general agreement with the arrangement of the edges of a tetrahedron. Some striking deviations occur, but are explicable by the variations in the composition of the lithosphere, and the existence of impassive blocks of old strata which have moulded the latter movements. The lines of the old fold-mountains of the Hercynian system may have been tetrahedrally arranged, with the axes occupying different positions from those of the great Cainozoic mountain system. So far, however, there is no completely satisfactory theory of geomorphology, for which we must wait for further information as to the distribution of land and water in successive epochs of the world's history; for the historical method promises more reliable results than the deductive method.

GENERAL.

Memoir of Sir Henry Rawlinson.—The full obituary notice of the late Sir Henry Rawlinson, which appeared in the *Journal* shortly after his death (vol. v., 1895, p. 490), set forth the leading facts of his remarkable career, and dwelt specially upon his long association with the Royal Geographical Society, and the many services he rendered to it. The Memoir* which has recently been published deserves special notice, however, on account of the unusual interest of the life it describes, and the high position of its subject in the geographical, as well as in the military, political, and scholarly worlds. That a life of such length and continuous activity, crowded with incident and adventure as it was, and involving the whole history of some branches of knowledge, *e.g.* the cuneiform records, should be described in one compact volume is a guarantee that the book contains nothing superfluous, and it certainly contains nothing dull. The concluding chapter summarizes Sir Henry Rawlinson's position and work as a geographer. His

* 'A Memoir of Major-General Sir Henry Creswicke Rawlinson, Bart., etc.' By George Rawlinson, M.A., Canon of Canterbury. With an Introduction by Field-Marshal Lord Roberts, of Kandahar. London: Longmans, Green & Co. 1898.

geographical labours commenced in 1836, and continued throughout his long life, and the appreciations of a succession of presidents of the Society are quoted in support of the claim that Sir Henry Rawlinson possessed in unusual, indeed in a unique, degree the qualities of a geographer in the fullest sense of that word. Instances are happily not few in which recondite sciences have been advanced by the leisure studies of British officers in the field, but there are not many who have given so splendid a demonstration of the combination of military ardour and scientific enthusiasm.

An Illustrated School Geography.*—Dr. Herbertson has prepared, on the basis of Frye's 'Complete Geography' (see *Journal*, vol. vii., 1895, p. 571), and in the same large quarto form, a school-book of a type not hitherto attempted in this country. It has been adapted for British needs by rewriting the section on the United Kingdom and the United States, greatly extending the former, and considerably reducing the latter. The rest of the book is also so much modified that the whole letterpress may be taken as new, only the series of beautiful illustrations has been taken over from the American book without alteration, except for the addition of some characteristic views of the British Islands. A set of coloured maps by Bartholomew, occupying sixteen pages, makes an atlas unnecessary, and, taking this into consideration, the book is remarkably cheap. It remains to be seen whether this form will prove popular; but if it fails to please, it will be on account of the form alone. The contents are well chosen, and the style is adapted to the requirements of young scholars. With the exception of one or two half-tone illustrations, which compare unfavourably with the woodcuts, the whole get-up of the book is satisfactory, in no way behind the best American work.

An American School-book.—The 'Natural Advanced Geography,' by Messrs. Redway and Hinman,† is deserving of notice as the most remarkable of recent American school geographies. It shows all the good points of this type of book advanced to a surprising excellence, but most of the unsatisfactory features of the type are perpetuated, though rendered much less conspicuous than has formerly been the case. The introductory part dealing with the principles of geography is put together with much discrimination, and embodies the best of many earlier text-books, American and British. The description of the United States leaves little to be desired, and the illustrations are very fine, really illustrating the text, whether in the form of pictures, statistical diagrams, or maps. So far the book is a solid gain to educational literature. But the few pages which dismiss the rest of America and the whole eastern hemisphere cannot fail to give a most erroneous impression to the United States scholars. The idea indicated in the general section that all monarchs were originally tyrants, and the implication that a limited monarchy is at best a mitigated evil, shows disregard of history; the duties of a sovereign, and the fact that in certain stages of civilization a land without a leader was doomed to disappear, are not touched on. In the limited space assigned to other countries, it is simply impossible to convey correct impressions of them, and it might be better to restrict the study of geography to the home-country altogether. It is by no means unlikely that the recent trend of events in the United States will lead to a real demand for school-teaching regarding other lands, and, while it would be most unfortunate to treat the home-country in less detail, it might well be so viewed as to obscure a little less of the great world than it does in the American school-books of to-day.

* 'An Illustrated School Geography.' By Andrew J. Herbertson. Partly based on Frye's 'Complete Geography.' London: Edward Arnold. 1898.

† 'Natural Advanced Geography.' By Jacques W. Redway, F.R.G.S., and Russell Hinman. New York, Cincinnati, Chicago: The American Book Company. [1898.]

OBITUARY.

Lieutenant-Colonel H. L. Wells, R.E., C.I.E.

By Major-General Sir FREDERIC J. GOLDSMID, K.C.S.I., C.B.

THE sad and quite unexpected death of Colonel Henry Lake Wells, at the comparatively early age of forty-eight, has not only thrown a gloom over Karachi, the scene of its occurrence, but also over the Department to which he belonged, and to which he had rendered such valuable aid during a long residence in the Shah's dominions. But before his appointment to Tehran in 1880, as an Assistant-director of the Telegraph, he had earned an honourable record, the nature of which may be shown in the following brief official summary.

Born on March 8, 1850, and receiving his commission as lieutenant of Engineers in 1871, young Wells, after special employment for more than one year in the office of the Inspector-General of Fortifications at the Horse Guards, qualified as Instructor in Army Signalling, and embarked for India, arriving in that country on December 18, 1875. Here his services were soon placed at the disposal of the commander-in-chief, and he became attached for a time to the Afghan Field Force. From January, 1878, to November, 1879, while an executive engineer, 3rd grade, in the Public Works Department, he was in sole charge at Quetta, where he had built the native cantonments; and we learn incidentally from the pages of Major Le Messurier's 'Kandahár in 1879,' as well as by the official statement, that the Ghilzai labourers who constructed the road across the Khojak worked under his superintendence. It should be noted, moreover, that before his transfer to Persia in 1880, with the higher rank of captain, he was employed on special duty in the Indian Telegraph, to survey and report upon routes in Kashmir and Gilgit, for a line of wire communication proposed to be established between Srinagar and the latter place.

For the eighteen years which passed since the deceased officer joined his countrymen in Persia, the official record bears ample testimony to his energy and usefulness. In the first instance, assistant-director, and for a short time officiating director, of a Department known as the "Government Indo-European Telegraph," he was appointed to officiate as director of the Persian Section on return from leave to England in 1885. During the many years spent in the fulfilment of these duties, some estimate of the character as well as value of his work may be gathered from the frequent attestations of the several authorities with whom he came in contact. Independently of the recorded acknowledgments of his own director-in-chief, the Director-General of Telegraph in India, the Government of India, and the directors of the Indo-European Telegraph Company, he received the thanks, for assistance afforded on special occasions, of Her Majesty's Commissioner for the delimitation of the Afghan frontier, in 1886; of the Director of Army Remount operations for India, in 1887; and of the French Consulate at Bushire and our own Political Resident in the Persian gulf, in 1890. We further take particular note of not only the recorded approval, but the grant of a sword of honour on the part of H.I.M. the Shah; a vote of thanks by the Board of Directors Indo-European Telegraph Company, "for admirable spirit and example set during the cholera epidemic of 1893;" and, finally, the thanks of the Secretary of State "for arrangements made during the revolution that took place at Shiraz in May, 1893."

Captain Wells received the local rank of major in March, 1885, having previously qualified for such promotion, and obtained, about the same time, a certificate of distinction in Military Law. When substantive major, he was also granted the

local rank of lieut.-colonel, for which he subsequently passed the required examination. As regards linguistic qualifications, he passed the higher standard of examination in Persian so far back as May, 1883. His war services include the Afghan campaign of 1878–80; the raising a corps of Ghilzais, to which allusion has already been made; an engagement near the Khojak, in which he commanded detachments of Panjab cavalry and Sind horse, and was wounded; accompanying the leading column of General Biddulph's force down the Thal Chotiali route; the action at Baghao; service with the Khaibar line force in 1879–80; the action of Mazina, where he was present as General Gib's orderly officer; and having charge of pontoons at the crossing of the Kabul river. Publicly thanked in the *London Gazette*, November 7, 1879, and later on in the *Gazette of India*, May 27 and August 14, 1880, he was mentioned in General Biddulph's despatches, dated May 18, 1879, for the skill displayed in making the road over the Khojak, and in General Doran's despatches, dated June 18, 1880, as having done "admirable service." The *Army and Navy Gazette*, in notifying that he took up his appointment as Director of the Gulf Section of the Government Telegraph on September 1 ult., and had received the C.I.E. from Her Majesty at Windsor in the previous July, adds, "The loss of this distinguished officer is greatly deplored, for a bright future seemed to be before him after all the good work he had done. To be mentioned in despatches on five occasions, three of which were for services rendered in action, was no mean record for a subaltern officer, detached for a brief period beyond the north-west frontier of India."

As the author of professional and geographical papers for Government, or departments of Government, or published by the Institute of Royal Engineers, or in the journals of a learned society, Colonel Wells received, on more than one occasion, the thanks of H.M. Secretary of State for Foreign Affairs for information supplied. Among his papers contributed to the *Journal* of the Royal Geographical Society (of which he had become a Fellow in 1880), those contained in vol. v., New Series, are of considerable importance, and throw much light on the lines of communication in Southern and South-Western Persia. In alluding to this subject in the course of his Annual Address for 1882–83, our then President, the late Lord Aberdare, spoke of the series of route-maps sketched out by Captain Wells, as adding "materially to our knowledge of this part of Persia." The late Sir John Bateman-Champain, R.E., on the same occasion, referred to the carefully surveyed plan of the rocks which impede the course of the Karun river, by which Captain Wells, and those whose knowledge of the country was obtained from that officer's reports, could form a conclusion on the better course to be adopted to meet the difficulties which had to be overcome. The above-mentioned officer, then Director-in-chief of the Indo-European Telegraph Department, alluded also to notes and plane-table surveys of several routes explored by Wells between Dizful and Shiraz, which he thought would "prove of great utility to future travellers." At the reading of one of Captain Wells's papers a few years ago before the Society of Arts, the present writer had the honour of presiding.

It must not be inferred that, as a rule, employment in the Persian telegraph—from the days of its early and quasi "non-regulation" system of procedure up to its regularization on "up-to-date" principles—offered any special advantages to the young engineer officer. But the new field was interesting, and it was only fair to suppose that the early pioneers of Indo-European telegraphic communication would be duly rewarded for their labours, should the end, then so urgently sought for by merchants and politicians, be satisfactorily attained, and that they would not suffer in position owing to absence from India or the natural sphere of their duties elsewhere. Whether such hopes have been fulfilled or not, it is hardly our province

to inquire. Moreover, death has removed many distinguished members of the Persian Telegraph Mission in the zenith of their respective careers—honest, high-minded labourers, such as Patrick Stewart, Bateman-Champain, Oliver St. John, William Henry Pierson—men who, like their brother engineers in the Palestine Exploration Fund, have made an honourable reputation for themselves in a special sphere of their own. Last on the list is Henry Lake Wells, who joined the establishment some eighteen years ago. Be it understood, however, that no statement of good service performed by the Royal Engineers in Persia would be complete without recognition of the able and zealous non-commissioned staff who worked so zealously for their chiefs during the last thirty-seven years.]

Colonel Wells was taken ill at Karachi on August 25, having only arrived there from England on the first day of that month. On the night of the 31st he died. The doctors found that a touch of the sun may have combined with enteric fever to aggravate his sickness. Of the loss sustained in the domestic circle, it is difficult to speak so soon after the event. The blow has been both sudden and heavy; but though sympathy is only perhaps a poor palliative, it will assuredly be genuine in the present case.

Henry Wells was the son of the late Rev. T. B. Wells, Rector of Portsmouth, Devon, who served in the navy in his younger days, and fought at Algiers in 1816, when midshipman of the *Granicus*. A brother, Lieut. Lewis Fortescue Wells, greatly distinguished himself during the Ashanti war of 1873, and was mentioned several times in despatches. He led fifty seamen and marines on to the flank of a large Ashanti force attacking the castle at Elmina, and was thanked on the field by his commanding officer. For this service he was appointed to H.M. Yacht *Victoria and Albert*, but died of yellow fever on the homeward voyage.

It is only right that the following testimony, spontaneously tendered by the Director-in-chief of the Department to which Colonel Wells was attached, should here be added: "I have been working with him for years, and I certainly have never met a more honourable man. . . . He was most careful in preventing any unnecessary expenditure of Government money, and through his careful watchfulness of the traffic, he helped to maintain the Indo-European telegraph route, as the most accurate and most rapid communication with India and the Far East."

The Right Hon. Sir George Grey, K.C.B.

The veteran colonial statesman who has recently passed away from among us was one of our oldest members, having joined our Society in 1837, or only seven years after its foundation. Sir George Grey, whose name will always be prominently connected with the history of our colonies in the Southern hemisphere, was at the same time a contributor to the cause of geographical science, although his services in this direction were eventually eclipsed by his work in a wider sphere. It was, in fact, as an explorer that his name first came before the public in connection with the Australian colonies, in which so much of his after-life was spent. Born in 1812, and educated for the military profession, he obtained a commission in 1830, and served for a time in the west of Ireland; but in 1837, his attention having been directed to the Australian colonies as a home for our surplus population, he put forward a proposal for an exploring expedition in the north-west of the island continent. His ideas were taken up by the Royal Geographical Society, and the influence of the President was exerted to obtain a grant from the Colonial Office for the proposed expedition. In spite of great difficulties and hardships, some valuable work was done, and after the publication, in 1841, of a narrative of his journeys, he received from Lord John Russell the important appointment of Governor of South

Australia. This was the beginning of a long period of colonial administration, during which he rendered incalculable services to colonies struggling with difficulties of all kinds. As Governor of New Zealand, in 1845, he promptly repressed the Maori insurrection, and advanced the prosperity of the colony by wise measures of internal administration. After a visit to England, he was, in 1854, appointed to the Government of the Cape, then passing through an unusually stormy period, and again proved his genius for rule by the suppression of the Kaffir rebellion, by the improvement of relations with the Hottentots and Boers, and by the initiation of public works essential to the prosperity of the country. Again called to New Zealand in 1861, he marked his second governorship by the pacification of the Maoris and the establishment of permanent friendly relations between them and the whites. After a visit to England, followed by some years spent in retirement at his island home at Kawau, he became a member of the New Zealand parliament in 1875, and took an active part in the political affairs of the colony, becoming premier in 1877. His policy was marked, as always, by strong democratic leanings. In 1890 he again retired to Kawau, and five years later came to England, where the last three years of his life were spent. He had served on the Council of our Society in 1869–70.

Colonel Don Francisco Coello de Portugal y Quesada (President of the Spanish Geographical Society).

By Sir Clements R. Markham, K.C.B., F.R.S.

Our respected associate, Don Francisco Coello, died on the 30th of last September. He had been an Honorary Corresponding Member of our Society since 1850, a period of nearly half a century, and had frequently rendered us valuable assistance in advising us respecting and in transmitting to us geographical publications. He was appointed Spanish delegate to the International Geographical Congress in 1895, but was unable, through ill health, to come to this country.

Colonel Coello left the military academy in 1839, and, entering the Spanish Corps of Engineers, became a captain in 1844, and colonel in 1865. As a geographer he was zealous and indefatigable, the most important result of his labours being the Atlas of Spain and her Colonies. Among his other works was a memoir on the towns, roads, and ancient ruins of the province of Alava. Coello was one of the founders of the Spanish Geographical Society, and its chief supporter, being perpetual President. Our venerable colleague was a learned geographer, a man of simple habits, an untiring worker, and a high-minded gentleman. He had been decorated by his own Government with the Grand Cross of Military Merit; and had received recognitions from other governments, as well as from numerous scientific societies. Don Francisco Coello leaves a widow and two children. We offer to his family, and to his colleagues at Madrid, our warm sympathy for the great loss they have sustained.

Dr. Don Luis Carranza.

A letter has been received from Dr. Don Ricardo Florez, Vice-President of the Lima Geographical Society, announcing the lamented death of its President, our Honorary Corresponding Member, Dr. Don Luis Carranza, on July 28 last. The Peruvian society was founded in 1888, and Dr. Carranza, who was a Senator and Councillor of State, had been its President since 1890. Besides conducting the administrative work of the society with great zeal and distinguished ability, Dr. Carranza has contributed numerous valuable papers to the *Boletin*, and has submitted annual memoirs on the progress of geographical work in Peru to the

members of the society of which he was President. Dr. Florez truly says, in his letter, that Dr. Carranza's lamented death leaves a blank which it will be very difficult to fill.

Cesare Pomba.

We regret to record the death of Cavaliere Cesare Pomba, an Italian geographer of some note. Born in 1830, and thoroughly grounded both in mathematical and literary studies, he devoted himself especially to geography, without, however, withdrawing himself from practical affairs. He took much interest in agriculture, and was connected with the municipal government of his native city of Chieri. To geographers he is best known for his relief map of Italy, constructed after his own ideas in such a way that the curvature of the earth was duly shown, while the true proportion between the vertical and horizontal scales was preserved. Signor Pomba attended the meeting of the International Geographical Congress in London in 1895, in connection with which he published a brochure, setting forth the principle of his relief map. His kindly disposition prompted him to many acts of courtesy to foreign geographers visiting Italy.

Max Ritter von Proskowetz.

The death, through an accident, of the Chevalier von Proskowetz, Austrian Consul at Chicago, has lately been announced. The deceased, who joined our Society in 1890, was the son of Emanuel von Proskowetz, of Kwassitz, Moravia. In 1888, after the opening of the Samarkand railway, he carried out a long-meditated journey through the Russian territory in Central Asia, subsequently giving an account of the same to the public in his work 'Von Nevastrand nach Samarkand,' to which Prof. Vambéry contributed an introduction. The object of his journey was to examine for himself the progress of Russian civilization in Asia, and, being a careful observer, he brought back information of considerable value as regards the economic, commercial, and industrial conditions in the countries traversed.

CORRESPONDENCE.

Lake Boanensis.

A False Reading in Evagrius ii. 14.

The two editors of the forthcoming volume of Evagrius (which is to be the first instalment of Mr. Methuen's reissue of Byzantine Texts under Prof. Bury's general editorship), Prof. Parmentier of Liege and M. Bidez of Gaud, have recently called attention to a possible creation of a non-existing "Lake Boanensis" out of a false reading in Evagrius' 'Ecclesiastical History,' ii. 14. It is all but certain that transcriptional error gave birth to a heretic "Quintilla" in Portullian's 'De Baptismo,' 1, and it seems equally probable that "Lake Boanensis," which only exists in geographical indices in virtue of its supposed mention by Evagrius, must trace its genesis to the same source.

No one has ventured to mark its position on a map, though Kiepert in the last edition of his 'Formæ orbis antiqui' (ix. Asia Provincia) has printed the name as an alternative designation of *Lacus Sumonensis*. This, however, is a mere guess as old as Valesius (see his note on Ammian. Marc. xxvi. 8). The paper referred to appeared in tome xl. of the *Revue de l'instruction publique en Belgique*, and it may be of interest to give a brief *résumé* of it, preface1 by the words of Evagrius on which it is founded.

Καὶ ὄμβρους δὲ ἐξαισίους ὁ Πρίσκος ἱστορεῖ γενέσθαι ἀνὰ τὴν Κωνσταντινούπολιν καὶ τὴν Βιθυνῶν χώραν, ἐπὶ τρεῖς καὶ τέσσαρας ἡμέρας ποταμηδὸν τῶν ὑδάτων ἐξ οὐρανοῦ φερομένων. Καὶ ὄρη μὲν ἐς πεδία κατενεχθῆναι· κατακλυσθείσας δὲ κώμας παραπολέσθαι· γενέσθαι δὲ καὶ νήσους ἐν τῇ Βοάνῃ λίμνῃ, οὐ μακρὰν τῆς Νικομηδείας ἀφεστώσης, ἐκ τῆς συνενεχθέντων ἐς αὐτὴν παμπόλλων φορυτῶν.

So Evagrius ii. 14. But this Βοάνη λίμνη is mentioned nowhere else in the whole of Greek or Byzantine literature, while an examination of the manuscripts of Evagrius reveals the existence of another reading, not in itself acceptable, but which at least points to what was most probably the true original.

Βοάνη λίμνη has the support of four manuscripts, all of which represent only one type of text, which has been better preserved in codd. Laurentianus 695 and Patmiacus 688. Another type, wholly independent of these, exists in cod. Laurentianus 70, 23, and, so far as it has been examined, it appears to present a truer and correcter text than any other. For instance, in Evagrius iii. 8, where the other manuscripts place the death of the usurper Basiliscus ἐν Ἀκουσῷ, this manuscript gives the correct reading ἐν Κουκουσῷ, which is confirmed by Theophanes.

Now, in the passage under discussion, it reads ἐν τῇ καικιανῇ λίμνῃ instead of ἐν τῇ Βοάνῃ λίμνῃ. What can be made of καικιανῇ? There are in the neighbourhood of Nicomedia only two lakes, between which we must choose for the scene of the phenomena related by Priscus—Sumonensis (Sophon) and Ascania. Sumonensis is nearer to Nicomedia, but the name does not lend itself to the elucidation of the manuscripts. If, however, Ἀσκανίᾳ were the original reading, it is just possible that careless writing of the word led to a supposed correction, Βοάνῃ—Κ and Β being often confused in the manuscripts. But it is much more likely that our manuscript has preserved the true reading Κιανῇ, and that an *iotacism* (Κοιανῇ, Βοάνῃ) has to account for the error in the common texts.

Now, the channel which connects Lake Ascania with the gulf of Cius (Κιανὸς κόλπος) is termed by Strabo and Pliny the *River Ascanius*, but it appears to be also called *Cius amnis* (Plin. 'H.N.,' v. 32. § 144). It is argued, therefore, that the lake, like the river, could be termed indifferently Ἀσκανία λίμνη, or Κιάνη λίμνη, and that Evagrius wrote the latter. Thus, with regard to the *Boanensis lacus*, the writers of the paper here summarized conclude, "que ce lac livresque de la Bithynie est définitivement desséché."

The only criticism which one is inclined to make on this ingenious piece is that Pliny's words do not clearly identify the *flumen Ascanium*, which flows into the *Cianus sinus*, with the *amnis Cius*. His geographical notes are often extremely perplexing; but he is here describing the coast northwards from the Hellespont; and his words are, "Postea sinus in quo flumen Ascanium, oppidum Bryalion, amnes Hylas et Cius cum oppido ejusdem nominis." Here we have the gulf, the river, the town, and the two streams with a second town. The streams may indeed be the outlets of the Ascanius, for Ptolemæus ('Geogr.,' v. 1) speaks of the ἐμβολαί of the Ascanius; and Smith and Grove's Atlas boldly names the connecting channel *Cius F.*, ignoring the *flumen Ascanium* entirely. But these streams may equally well be different ones near to the town Cius.

T. Herbert Bindley.

Codrington College, Barbados.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce, Commercial.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
M. = Mitteilungen.
Mag. = Magazine.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue, Revista.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

Austria-Hungary. **Schoeller.**

Trade of Austria-Hungary for the year 1897. Foreign Office, Annual No. 2160, 1898. Size 10 × 6½, pp. 32. *Price* 2*d*.

Belgium—Dochamps. *B.S.R. Belge G.* 22 (1898): 113–136, 204–221. **Delacollette.**

La commune de Dochamps. Par Louis Delacollette. *With Map.*

A piece of local descriptive geography.

Bulgaria. ———

Trade of Bulgaria for the year 1897. Foreign Office, Annual No. 2159, 1898. Size 10 × 6½, pp. 52. *Price* 3*d*.

France—Cherbourg. **Gurney.**

Trade and Agriculture of Cherbourg and District for the year 1897. Foreign Office, Annual No. 2035, March, 1898. Size 10 × 6, pp. 50. *Price* 3*d*.

France—Paris. **Baedeker.**

Paris and Environs, with Routes from London to Paris. Handbook for Travellers by Karl Baedeker. With 12 Maps and 33 Plans. Thirteenth Revised Edition. Leipsic: Karl Baedeker; London: Dulau & Co., 1898. Size 6½ × 4½, pp. xlvi., 428, and 24. *Presented by Messrs. Dulau & Co.*

France—Rouen. **O'Neill.**

Report for the year 1897 on the Trade, etc., of Rouen. Foreign Office, Annual No. 2027, 1898. Size 9½ × 6, pp. 22. *Price* 1½*d*.

Germany. *Deutsche Rundschau G.* **20** (1898): 615-516. ———

Der Rhein-Weser-Elbe-Canal. *With Map.*

Germany. *Tijds. K. Ned. Aard. Genoots. Amsterdam*, 15 (1898): 477–487. **Beekman.**

Het Dortmund-Eemskanaal. Door A. A. Beekman. *With Map.*

A description, with map, of the new canal from Dortmund to the Ems.

Germany. **Frisch.**

Die Vegetations-Verhältnisse und die Flora des Pöhlberg-Gebietes. Inaugural-Dissertation der hohen Philosophischen Facultät der Universität Leipzig zur Erlangung der Doctorwürde vorgelegt von Alban Frisch aus Annaberg. Annaberg, 1897, Size 9 × 6, pp. 96. *Presented by Prof. Ratzel.*

Germany. **Koenig.**

Agriculture in Germany. Foreign Office, Miscellaneous, No. 452, 1898. Size 9½ × 6½, pp. 86. *Price* 4½*d*.

Germany. **Mulvany.**

Coal Industry of the Rhenish Westphalian Provinces. Foreign Office, Miscellaneous, No. 454, 1898. Size 10 × 6, pp. 60. *Price* 6½*d.*

Germany—Bavaria. **Harford.**

Report for the years 1896-97 on the Trade and Agriculture of Bavaria. Foreign Office, Annual No. 2024, 1898. Size 9½ × 6½, pp. 22. *Price* 1½*d.*

Germany—Hamburg. **Ward.**

Trade of Hamburg and District for the year 1897. Foreign Office, Annual No. 2104, 1898. Size 10 × 6½, pp. 82. *Price* 5*d.*

Germany—Spree Valley. **Schwager.**

Die geographische Mannigfaltigkeit des oberen Spreethales in ihren ursächlichen Beziehungen zur Natur und zur Thätigkeit des Menschen. Inaugural-Dissertation . . . von Hermann Schwager aus Ebersbach. Zittau, 1898. Size 8½ × 6, pp. 86. *Presented by Prof. Ratzel.*

An essay on the geography of the Upper Spree Valley, with reference both to physical conditions and human settlements.

Greece. **Woodhouse.**

The Greeks at Plataiai. By W. J. Woodhouse. Reprinted from the *Journal* of *Hellenic Studies*, vol. xviii., 1898. Size 11 × 7½, pp. 33-59. *Map. Presented by the Author.*

A criticism of Mr. Grundy's work on the Battlefield of Platæa, the geographical portion of which is accepted as correct, and attention called merely to some matters of military and historical interest.

Greece—The Cyclades. **Cottrell.**

Trade of the Cyclades for the year 1897. Foreign Office, Annual No. 2102, 1898. Size 10 × 6½, pp. 18. *Plan. Price* 2½*d.*

Hungary—Lake Balaton. ———

Resultate der wissenschaftlichen Erforschung des Balatonsees. Herausgegeben von der Balatonsee-Commission der Ung. Geographischen Gesselschaft. Erster Band. Physikalische Geographie des Balatonsees und seiner Umgebung. Sechster Theil. Die chemischen Verhältnisse des Balatonsee-Wassers. Von Dr. Ludwig Ilosvay von Nagy Ilosva (pp. 30). Ditto. Zweiter Band. Die Biologie des Balatonsees und seiner Umgebung. Zweiter Theil, Die Flora des Balatonsees. Erste Section. Die Kryptogamen Flora des Balatonsees und seiner Nebengewässer. Von Prof. Dr. Gy. von Istvánffi. Wien: E. Hölzel, 1898. Size 11½ × 8½, pp. 148.

Italy. *B.S.G. Italiana* 11 (1898): 466–470. **Agostini.**

Il lago di Canterno (Sub-Appennino Romano). Notizie del socio dott. G. De Agostini. *With Sketch-map.*

Italy—Teramo. **Magistris.**

Monografia della provincia di Teramo. [Review.] L. F. de Magistris. [Estratto dalla *Rivista Geografica Italiana.* Anno v., fascicolo ii.–iii., 1898.] Firenze. Size 9½ × 6½, pp. 8. *Presented by the Author.*

Italy—Venice. **Allen.**

Grant Allen's Historical Guides. Venice. London: Grant Richards, 1898. Size 7 × 4½, pp. 270. *Price* 3*s.* 6*d. Presented by the Publisher.*

The object of these guides is, not to cover the ground already amply occupied by the usual guide-books, which travellers have learned to trust in practical matters, but to encourage and assist the study of individual towns from the point of view of their historical evolution as recorded in buildings and works of art. Hence the description of Venice necessarily begins with and depends on the physical geography of the region which made it possible for a city of the early middle ages to be at once an emporium of commerce and a sanctuary of art.

Mediterranean. **Radde.**

Deutsche Rundschau G. **20** (1897–98): 1, 66, 103, 150, 211, 259, 299, 348, 398, 458.

Zwei Fahrten in das Mittelmeer in den Jahren 1895 und 1897 auf den kaiserl. russischen Yachten *Polarstern* und *Sarniza.* Von Dr. G. Radde. *With Illustrations.*

Mediterranean—Cyprus. ———

Cyprus. Annual Reports for the year 1896-7. 1898. Size 10 × 6, pp. 84. *Price* 4½*d.*

Norway—Climate. *Skrifter Vidensk. Christiania* (1897): 1–11. **Mohn.**

Klima-Tabeller for Norge. III. Luftens Fugtighed. Af H. Mohn.

These tables give monthly and yearly means of atmospheric humidity for a large number of stations in Norway.

Rockall. *Scottish G. Mag.* **14** (1898): 393–415. **Christy.**

Rockall. By Miller Christy. *With Charts and Illustrations.*

The most complete account of Rockall yet compiled.

Rumania. **Lahovari.**

Dicţionar Geografic al Romînieĭ . . . de George Joan Lahovari, şi General C. I. Brătianu, Grigore G. Tocilescu. Vol. i. Fasc. i.–iii. Aaron-Vodă.—Botoşanĭ. Bucureşti: J. V. Socecŭ, 1898. Size 13 × 9½.

The first parts of a very detailed geographical dictionary of Rumania published by the Rumanian Geographical Society.

Rumania. **Liddell.**

Trade of Galatz and District for the Year 1897. Foreign Office, Annual No. 2100, 1898. Size 10 × 6½, pp. 22. *Price* 1½*d.*

Russia. *Tour du Monde* **4** (1898): 313, 325, 337, 349, 361. **Meunier.**

Voyage d'un Congrès en Russie. Par M^me^ Stanislas Meunier. *With Illustrations and Maps.*

A finely illustrated account of the excursion following the recent International Geological Congress.

Russia. **Michell.**

Trade and Agriculture of Northern Russia, including Finland, for the year 1897. Foreign Office, Annual No. 2169, 1898. Size 10 × 6½, pp. 96. *Price* 5*d.*

Russia. **Smith.**

Beetroot Sugar Industry in Russia since its First Introduction in 1800. Foreign Office, Miscellaneous, No. 471, 1898. Size 10 × 6½, pp. 22. *Price* 1½*d.*

Russia. *Z. Ges. Erdk.* **33** (1898): 77–110. **Philippson.**

Geographische Reiseskizzen aus Russland. Das Russische Flachland. Von Dr. Alfred Philippson.

Russia—Finland Peat-bogs. **Andersson.**

Om flott-tegar i Finland. Af Gunnar Andersson. (Aftryck ur Geol. Fören. i Stockholm Förhandl. Bd. 20, Häft. 2, 1898.) Size 8½ × 5½, pp. 8. *Plans. Presented by the Author.*

Russia—Odessa. **Stewart.**

Report for the Year 1897 on the Agriculture of the Consular District of Odessa. Foreign Office, Annual No. 2023, 1898. Size 10 × 6½, pp. 20. *Price* 1½*d.*

Russia—Taganrog. **Hunt.**

Trade of Taganrog and District for the year 1897. Foreign Office, Annual No. 2076, 1898. Size 10 × 6½, pp. 32. *Price* 2*d.*

Russia—Ural. **Philippson.**

Geographische Reiseskizzen aus dem Ural. Von Dr. Alfred Philippson. [Aus den "Sitzungsberichten der Niederrhein. Ges. für Natur- und Heilkunde." Bonn, 1898.] Size 9 × 6, pp. 54. *Map and Profiles.*

A detailed account of the excursion through the Ural region during the meeting of the International Geological Congress in Russia in 1897.

Spain. *B.S.G. Madrid* **40** (1898): 54–78. **Blázquez.**

Vias romanas españolas. Por Antonio Blázquez y Delgado Aguilera.

On the Roman roads in Spain.

Spain. **Harrison.**

Trade of Spain for the year 1897. Foreign Office, Annual No. 2065, 1898. Size 10 × 6, pp. 38. *Price* 2½*d.*

Spain. *B.S.G. Madrid.* **40** (1898): 7–41. **Quirós.**

Hallazgos de Villaricos y luz que arrojan sobre nuestra geografia historica al sudeste del litoral Mediterráneo, por el Rvdo. P. Fr. Paulino Quirós.

On the discovery of the site of Villaricos, which is identified with Barea at the mouth of the Almanzora, in the south-east of Spain.

ASIA.

Asia. **Hedin.**

Through Asia. By Sven Hedin. 2 vols. London: Methuen & Co., 1898. Size 10 × 7, pp. 1278. *Maps and Illustrations. Price* 36*s. Presented by the Publishers.*

This great work represents the results of three and a half years' continuous travel and observation on the Pamirs, in the deserts of Taklamakan and the Lob-nor region, and in Tsaidam and Southern Tibet. The geographical results have been summarized by Dr. Hedin in the *Journal* from time to time. The book is illustrated by admirable maps, photographs, sketches, and coloured plates. It will be separately noticed.

Caspian Sea. *Iz. Imp. Russian G.S.* **34** (1898): 205–208. **Shpindler.**

Notes on the Temperature of the Caspian Sea. By I. B. Shpindler. [In Russian.]

Central Asia. *Globus* **74** (1898): 93–98. **Stieda.**

Jaworskis anthropologische Skizze der Turkmenen. Von L. Stieda. *With Illustrations.*

China. *J. China Br. R. Asiatic S.* **28**, 1893–94 (1898): 1–213. ——

Inland Communications in China. *With Maps.*

The Council of the China Branch of the Royal Asiatic Society sent out a circular to missionaries and others in 1890, asking for information as to the roads and other means of communication in the various provinces of China. The result is a valuable mass of data on the ancient and modern roads and tracks, with particulars as to rivers, ferries, inns, etc., illustrated by maps. The names are given in the Chinese ideographs, with a transliteration.

China. *Globus* **74** (1898): 69–71. ——

Das zukünftige Eisenbahnnetz Chinas. *With Map.*

China. ——

China. Imperial Maritime Customs. I.—Statistical Series: Nos. 3 and 4. Returns of Trade and Trade Reports for the year 1897. Part II.—Reports and Statistics for each Port. With Report on Foreign Trade of China. Shanghai: Kelly and Walsh; London: P. T. King & Son, 1898. Size 11 × 9, pp. xiv. and 680. *Maps and Diagrams.*

China. **Jamieson.**

Journey from Hong-Kong to Ssümao. Foreign Office, Miscellaneous, No. 473, 1898. Size 10 × 6½, pp. 10. *Price* 1*d.*

Mr. Jamieson left Hongkong on December 18, 1898, landed at Haifong in Tongking, proceeded by river to Laokay, and thence by land to Ssumao, which he reached "on the 14th instant," but the report is not dated.

China. **Litton.**

Journey from Yachon to Tachienlu. Foreign Office, Miscellaneous, No. 475, 1898. Size 10 × 6½, pp. 16. *Map. Price* 2½*d.*

A journey from Yachon, on the Ya river, the key to the central plains of Ssuchuan, through the high mountain valleys to Ta-chien-lu, on the Tibetan border.

China. **Mansfield.**

Trade of Shanghai with Soochow and Hangchow for the year 1897. Foreign Office, Annual No. 2156, 1898. Size 10 × 6½, pp. 32. *Price* 2*d.*

China. *Nineteenth Century* **44** (1898): 386–399. **Moreing.**

A recent business tour in China. By C. A. Moreing.

This article deals rather with opinions formed than places visited; but some notice is taken of Shanghai and Peking.

China. *Deutsche Kolonialzeitung* **15** (1898): 268–272. **Tiessen.**

Die gegenwärtige Lage in China. Begleitworte zu einer Kartenskizze von Dr. E. Tiessen. *With Map.*

The map shows railways completed, in construction, and projected, and also the "spheres of interest" of the various European Powers.

China. *J.R. United Service I.* **42** (1898): 941–966. **Wagner.**

Two Memoranda regarding the Defences, Harbours, and Railways required by China. By Lieut.-Colonel Rheinhold Wagner. Translated by Captain P. Holland. *With Maps.*

China—Canton. **Brenan.**
Trade of Canton for the year 1897. Foreign Office, Annual No. 2175, 1898. Size 10 × 6, pp. 14. *Price* 1*d.*

China—Hainan. *B.S.G. Paris* **19** (1898): 187–228. **Madrolle.**
Étude sur l'île d'Hai-nan. Par Cl. Madrolle. *With Map.*

China—Manchuria. *Iz. Imp. Russian G.S.* **34** (1898): 117–184. **Komaroff.**
Manchurian Expedition, 1896, by V. L. Komaroff. [In Russian.]

China—Ningpo. **Playfair.**
Trade of Ningpo for the year 1897. Foreign Office, Annual No. 2073, 1898. Size 9½ × 6½, pp. 8. *Price* ½*d.*

China—Wuhu. **Fraser.**
Trade of Wuhu for the year 1897. Foreign Office, Annual No. 2182, 1898. Size 10 × 6½, pp. 12. *Price* 1*d.*

China—Yangtse Valley. *Contemporary Rev.* **74** (1898): 363–374. **Little.**
The Yangtse Valley and its Trade. By Archibald Little.

Chinese Empire—Tibet. **Landor.**
In the Forbidden Land. An Account of a journey in Tibet, capture by the Tibetan authorities, Imprisonment, Torture, and ultimate Release. By A. Henry Savage Landor. Also various Official Documents, including the enquiry and report by J. Larkin, Esq., appointed by the Government of India. 2 vols. London: W. Heinemann, 1898. Size 9 × 6½, pp. (vol. i.) xx. and 320; (vol. ii.) xvi. and 264. *Map, Portraits, and Illustrations. Price* 32*s. Presented by the Publisher.*

Mr. Landor arrived in India on April 10, 1897, entered Tibet by the Lumpiya pass, north of Askote, in long. 80° 30′ E., on July 13, passed eastward along the south of the Mansarowar lake, and travelled eastward, descending the valley of the San-po until August 20, when he was captured by the Tibetans and brought back to Taklakot, where on September 11, 1898, he was met by friends and left Tibet. The book is profusely illustrated by sketches, some coloured, and a few photographs. It will be specially noticed.

Chinese History. **Hirth.**
Zur Kulturgeschichte der Chinesen. Nach einem Vortrag von Prof. Dr. Friedrich Hirth. Sonderabdruck aus der Beilage zur "Allgemeinen Zeitung" Nr. 147 and 148 vom 6 und 7, Juli 1898. München, 1898. Size 9 × 6, pp. 24. *Presented by the Author.*

A study of the history of Chinese civilization with remarks on the possibility of Western influence.

Cochin China—Saigon. **Tremlett.**
Trade of Saigon and District for the year 1897. Foreign Office, Annual No. 2060, 1898. Size 9½ × 6½, pp. 16. *Price* 1*d.*

India. *P.R.S.* **64** (1898): 1–61. **Christie, Turner, and others.**
Report on the Expedition to Sahdol, Rewah State, Central India, to observe the Total Solar Eclipse of 1898, January 22. By W. H. M. Christie, C.B., etc., and Prof. H. H. Turner, F.R.S.
Total Solar Eclipse of January 22, 1898. Preliminary Report on Observations made at Ghoglee, Central Provinces. By Prof. Ralph Copeland.
Total Eclipse of the Sun, January 22, 1898. Preliminary Account of the Observations made by the Eclipse Expedition and the officers and men of H.M.S. *Melpomene* at Viziadrug. By Sir Norman Lockyer, K.C.B., F.R.S.
Total Solar Eclipse of 1898, January 22. Preliminary Report on the Observations made at Pulgaon, India. By Captain E. H. Hills and H. F. Newall. *With Plates.*

India—Burma. *Scottish G. Mag.* **14** (1898): 449–464. **Sutherland.**
South Tenasserim and the Mergui Archipelago. By Wm. Sutherland. *With Illustrations.*

India—Historical. *J.R. Asiatic S.* (1898): 625–629. **Ferguson.**
The Settlement of the Danes at Tranquebar and Serampore. By Donald Ferguson.
Controverting Sir W. W. Hunter's account of the origin of Danish influence in India.

India—Survey Report. **Strahan.**
General Report on the Operations of the Survey of India Department administered under the Government of India during 1896–97. Prepared under the

direction of Major-General C. Strahan. Calcutta, 1898. Size 13 × 8½, pp. vi. 106, and lvi. *Maps and Plates. Presented by the Surveyor-General of India.*

The work of this Survey will be the subject of a special notice.

AFRICA.

Abyssinia. *Rev. Française* **23** (1898) : 480–484. ——

Abyssinie : La mission de Bonchamps.

African Islands. **Keller.**

Die Ostafrikanischen Inseln. Von Professor Dr. C. Keller. (Bibliothek der Länderkunde herausgegeben von Dr. Alfred Kirchhoff und Rudolf Fitzner. Zweiter Band.) Berlin : Schall & Grund, 1898. Size 10½ × 7, pp. viii. and 188. *Maps and Illustrations. Presented by the Publishers.*

This will be noticed elsewhere in the *Journal*.

Algeria. **Hay-Newton.**

Trade of Algeria for the years 1896–97. Foreign Office, Annual No. 2164, 1898. Size 10 × 6, pp. 40. *Price* 2½*d.*

Algeria—Sahara. *B.S.G. Paris* **19** (1898) : 229–260. **Foureau.**

Mon neuvième voyage au Sahara et au pays Touareg. Par F. Foureau. *With Map.*

This journey, occupying the early summer of 1897, led M. Foureau to Tasili, in the valley of the Igharghareu, in the Erg, about 600 miles south of Tugurt.

Algeria and Tunis. **Piesse.**

Collection des Guides-Joanne. Algérie et Tunisie. Par Louis Piesse. 8 Cartes et 22 Plans. Paris : Hachette et Cie., 1898. Size 6½ × 4½, pp. 54, lxvi., and 420.

Basutoland. ——

Basutoland. Annual Report for 1896–97. Colonial Reports, Annual No. 224, 1898. Size 10 × 6, pp. 56. *Price* 3*d.*

British Central Africa. *Nineteenth Century* **44** (1898) : 448–454. **Koe.**

An African Adventure. By A. B. Koe.

The adventure occurred in 1893, and included some bush travelling while hostilities between the British authorities and some of the native tribes were in progress.

British East Africa Railway. ——

Africa. No. 8 (1898). Report on the Progress of the Mombasa-Victoria (Uganda) Railway, 1897-98. London : Eyre & Spottiswoode. Size 13 × 8½, pp. 6. *Map. Price* 6½*d.*

British East Africa—Uganda. ——

Africa. No. 7 (1898). Papers relating to Recent Events in the Uganda Protectorate. London : Eyre & Spottiswoode. Size 13 × 8½, pp. 58. *Maps. Price* 9*d.*

British East Africa—Zanzibar. ——

Africa. No. 6 (1898). Correspondence respecting the Abolition of the Legal Status of Slavery in Zanzibar and Pemba. London : Eyre & Spottiswoode. Size 13 × 8½, pp. iv. and 86. *Price* 9*d.*

British East Africa—Zanzibar. **Newman.**

Banani : the Transition from Slavery to Freedom in Zanzibar and Pemba. By Henry Stanley Newman. London : Headley Bros. [1898]. Size 9 × 6, pp. viii. and 216. *Maps and Illustrations. Presented by the Author.*

This book contains much information on the conditions of social life in Zanzibar and Pemba, and on the resources and economic position of the islands.

British West Africa. **Mockler-Ferryman.**

The Imperial Library. Imperial Africa, the Rise, Progress, and Future of the British Possessions in Africa. By Major A. F. Mockler-Ferryman. Vol. i. British West Africa. London : the Imperial Press, 1898. Size 9 × 6, pp. xvi. and 512. *Maps and Illustrations. Price* 12*s.* 6*d. Presented by the Publishers.*

This important work will be noticed elsewhere.

Canary Islands. **Ferguson.**

Report on Agriculture in Las Palmas. Foreign Office, Miscellaneous, No. 451, 1898. Size 10 × 6½, pp. 14. *Price* 1*d.*

Central Africa—Tanganyika. *Nature* **58** (1898): 404–408. **Moore.**
The Marine Fauna in Lake Tanganyika, and the advisability of further exploration in the Great African Lakes. By J. E. S. Moore. *With Map.*

Congo State. *Mouvement G.* **15** (1898): 204–205. ——
Exploration du Loange et de la Kantsha affluents du Kasaï. *With Map.*

Congo State. *Mouvement G.* **15** (1898): 375–376. **Wauters.**
Notre Carte, l'Urua, pays des Baluba. Par A. J. Wauters. *With Map.*

Egypt. *J.R. Victoria I. (London)* **30** (1898): 193–203. **Hull.**
The Proposed Scheme for Embanking the Waters of the Nile at Assouan, in Upper Egypt. By Professor Edward Hull, LL.D., F.R.S.

German East Africa. **Werther.**
Die mittleren Hochländer des nördlichen Deutsch-Ost-Afrika. Wissenschaftliche Ergebnisse der Irangi-Expedition 1896–1897 nebst kurzer Reisebeschreibung. Im Auftrage der Irangi-Gesellschaft herausgegeben von dem Führer der Expedition C. Waldemar Werther. Berlin: H. Paetel, 1898. Size 12 × 8, pp. 494. *Maps and Illustrations. Presented by the Publisher.*
This will be referred to with other recent books on Africa.

NORTH AMERICA.

Alaska—Maps. **Phillips.**
Alaska and the North-West part of North America, 1588–1898. Maps in the Library of Congress. By P. Lee Phillips. Washington, 1898. Size 9 × 6, pp. 120. *Presented by the U.S. Government.*
This is one of the useful bibliographies of special regions now being published by the Library of Congress.

America—Explorations. *Deutsche Rundschau G.* **20** (1898): 506–512. **Jüttner.**
Fortschritte der geographischen Forschungen und Reisen im Jahre 1897. 2. Amerika. Von Dr. J. M. Jüttner.

Canada. *Mission Field* **43** (1898): 321–331. ——
Klondyke and its Approaches. By the Bishop of Caledonia. *With Illustrations.*

Great Lakes. *B. American G.S.* **30** (1898): 226–254. **Russell.**
Geography of the Laurentian Basin. By Israel C. Russell. *With Maps.*
The region of the great lakes is described first with regard to its geological history, especially the position and extent of the ice-sheet, the temporary lakes of the withdrawal of the ice, and the origin of the present lakes. Then the influence of the geographical conditions thus inaugurated upon the historical and economic conditions of the country is fully treated.

Mexico. **Carden.**
Cotton Manufacturing Industry in Mexico. Foreign Office, Miscellaneous, No. 453. 1898. Size 10 × 6½, pp. 32. *Price 2d.*

Mexico. **Romero.**
Coffee and India-Rubber Culture in Mexico. Preceded by Geographical and Statistical Notes on Mexico. By Matias Romero. New York and London: G. P. Putnam's Sons, 1898. Size 10 × 7, pp. xxvi. and 418. *Map and Plates. Price 14s. Presented by the Publishers.*
This work will be specially noticed.

North America—Lakes. **Callahan.**
Johns Hopkins University Studies in Historical and Political Science. Series XVI., Nos. 1–4. The Neutrality of the American Lakes and Anglo-American Relations. By James Morton Callahan, PH.D. Baltimore, 1898. Size 9½ × 6½, pp. 200.

United States—Baltimore. **Rutter.**
Johns Hopkins University Studies in Historical and Political Science. Fifteenth Series. IX. South American Trade of Baltimore. By Frank R. Rutter, PH.D., Baltimore, 1897. Size 10 × 6, pp. 88. *Diagram.*

United States—Baltimore and Ohio Railroad. **Reizenstein.**
Johns Hopkins University Studies in Historical and Political Science. Fifteenth Series. VII.-VIII. The Economic History of the Baltimore and Ohio Railroad, 1827–1853. By Milton Reizenstein, PH.D. Baltimore, 1897. Size 10 × 6½. pp. 88.

United States—California. **Moore.**

Trade and Agriculture of California for the year 1897. Foreign Office, Annual No. 2152, 1898. Size 10 × 6½, pp. 56. *Price* 3*d.*

United States—Census. ———

[Eleventh Census of the United States, 1890.] Report on Vital and Social Statistics. Part i. Analysis and Rate Tables (1896, pp. xviii. and 1060, maps and diagrams, size 12 × 9½). Compendium of the Eleventh Census, 1890. Part iii. [Miscellaneous Statistics] (1897, pp. 1150, size 12 × 8). Report on Population. Part ii. Washington, 1897. Size 12 × 9½, pp. clxxvi., 824, and 142. *Presented by the Secretary of the Interior, Washington.*

United States—Florida. **Chambers.**

Johns Hopkins University Studies in Historical and Political Science. Series XVI., No. 5. West Florida and its Relation to the Historical Cartography of the United States. By Henry E. Chambers, Baltimore, 1898. Size 9½ × 6½, pp. 60.

United States—New York. *B. American G.S.* **30** (1898): 183–225. **Tarr.**

The Physical Geography of New York. By R. S. Tarr. Part iv. The Influence of the Glacial Period upon Topography. *With Maps and Illustrations.*

Like the preceding parts, this is a valuable discussion of the bearing on topography of physical conditions.

United States—North Carolina. *B.S.G. Genève* **37** (1898): 101–118. **Dufour.**

La nature et la vie dans les Montagnes-Bleues (Caroline du Nord). Par M. Alfred Dufour.

United States—Philadelphia. **Speirs.**

Johns Hopkins University Studies in Historical and Political Science. Fifteenth Series. III.–IV.–V. The Street Railway System of Philadelphia, its History and Present Condition. By Frederic W. Speirs, PH.D. Baltimore, 1897. Size 10 × 6, pp. 124.

United States—Rhode Island. *Ann. New York A. Sci.* **11** (1898): 55–72. **Hollick.**

Notes on Block Island. By Arthur Hollick. *With Map, Chart, and Plates.*

This is concerned mainly with the biological conditions of Block Island, giving a reference to an earlier paper on its geology. There is a map, but it is unprovided with a scale.

CENTRAL AND SOUTH AMERICA.

Paraguay. **Holmes.**

Trade of Paraguay for the year 1897. Foreign Office, Annual No. 2121, 1898. Size 10 × 6½, pp. 16. *Price* 1*d.*

Paraguay. *M.G. Ges. Hamburg.* **14** (1898): 1–28. **Jerrmann.**

Der Unterlauf des Igatimi und der Gran Salto Guayrá des Alto Paraná. Von Captain Ludwig Jerrmann. *With Map.*

A graphic description of a journey in the boundary district between Paraguay and Brazil, with a detailed map of the great falls of Guayra.

Peru—Anthropology. **Dorsey.**

Field Columbian Museum. Publication 23. Anthropological Series. Vol. ii. No. 2. A Bibliography of the Anthropology of Peru. By George A. Dorsey. Chicago, 1898. Size 10 × 6½, pp. 51–206.

This is a carefully compiled bibliography arranged alphabetically under the authors' names. An index is promised, which will add much to its value. As every available work is included which bears in any way on Peruvian anthropology, the value of the work to geographers is necessarily great.

Peru. ———

Relaciones geográficas de Indias. Publícalas el Ministerio de Fomento. Perú 4 vols. Madrid, 1881, 1885, 1897. Size 12 × 8½, pp. (vol. i.) cliv., 216, and clx.; (vol. ii.) l., 242, and clviii.; (vol. iii.) xl., 276, and clxxvi.; (vol. iv.) 46 and cexliv. *Plate. Presented by Señor Marcos Jimeres de la Espada.*

Historical documents relating to the establishment of Spanish power in Peru and the exploration of that country.

Peru. **St. John.**

Trade and Finances of Peru for the year 1897. Foreign Office, Annual No. 2117, 1898. Size 10 × 6, pp. 22. *Price* 1½*d.*

Peru—Inambari. **Pando.**
Sociedad Geografica de La Paz (Bolivia). Expedicion del Coronel Don Jose Manuel Pando al Inambary. Circular e Informe de la Comision. La Paz, 1898. Size 9 × 6½, pp. 31. *Presented by M. V. Ballivián.*

Venezuela. *Deutsche Rundschau G.* **20** (1898): 394–398. **Sievers.**
Ein Schlammvulcan, Hervidero, in den Llanos von Maturin. Von Wilhelm Sievers. *With Illustrations.*

Virgin Islands. **Cookman.**
Virgin Islands. Report on the Condition of the Islands during 1897. Colonial Office, Miscellaneous, No. 10. London: Eyre & Spottiswoode, 1898. Size 10 × 6½, pp. 18. *Map. Price* 4½*d.*

AUSTRALASIA AND PACIFIC ISLANDS.

Australian Tribes. *J. and P.R.S. New South Wales* **31** (1897): 154–176. **Mathews.**
The Totemic Divisions of Australian Tribes. By R. H. Mathews.
A careful study of the systems of tribal divisions amongst the aborigines of New South Wales.

British New Guinea. *B.S.G. Italiana* **11** (1898): 385–399. **Giulianetti.**
Nella Nuova Guinea Britannica. Lettera di Amedeo Giulianetti. *With Map and Illustrations.*

British New Guinea. **Macgregor.**
Despatch from his Excellency the Lieutenant-Governor of British New Guinea, reporting Visit of Inspection to district lying between Port Moresby and the head-waters of the Goldie and Brown Rivers. [No. 3.] Brisbane, January 3, 1898. Size 13½ × 9, pp. 12. *Sketch-Map. Presented by the Colonial Office.*

Fiji. *American J. Sci.* **6** (1898): 165–167. **Agassiz.**
The Tertiary elevated Limestone Reefs of Fiji. By Alexander Agassiz.
A note will be given on this paper.

Hawaii. **Griffin.**
Library of Congress. List of Books relating to Hawaii (including references to collected works and periodicals). By A. P. C. Griffin. Washington, 1898. Size 9½ × 6, pp. 26.

New Hebrides. *Deutsche G. Blätter* **21** (1898): 110–112. **Greffrath.**
Die Neu-Hebriden. Von H. Greffrath.

New South Wales. ———
New South Wales. Sixteenth Annual Report of the Department of Lands, being for the year 1895. Sydney, 1896. Size 13½ × 8½, pp. iv. and 98. *Maps and Plans. Presented by the Agent-General for New South Wales.*

New South Wales. **Coghlan.**
The Wealth and Progress of New South Wales, 1896–97. By T. A. Coghlan. Sydney, 1897. Size 9 × 6, pp. 1028. *Map. Presented by the Agent-General for New South Wales.*

New South Wales. *P.I.Civil Engineers* **132** (1898): 302–312. **Burge.**
Surveys and other Preliminaries to Railway Construction in New South Wales. By C. O. Burge.

New South Wales—Meteorology. **Russell.**
Department of Public Instruction. Meteorology of New South Wales. Results of Rain, River, and Evaporation Observations made in New South Wales during 1896, with Maps and Diagrams. By H. C. Russell, B.A., etc. Sydney, 1897. Size 10 × 6, pp. liv. and 210.

New Zealand. **Dadelszen.**
Report on the Results of a Census of the Colony of New Zealand, taken for the night of the 12th April, 1896. By E. J. von Dadelszen. Wellington, N.Z., 1897. Size 11 × 8½, pp. viii. and 164.

MATHEMATICAL GEOGRAPHY.

Geodesy. ———
Veröffentlichung des Königl. Preussischen Geodätischen Institutes. Bestimmungen von Azimuten im Harzgebiete, ausgeführt in den Jahren 1887 bis 1891. Bestimmung der Längendifferenz Jerscheim—Kniel mittelst optischer Signale. Berlin: P. Stankiewicz, 1898. Size 11½ × 9, pp. 88. *Plate.*

Geodesy—Gravity Observations. **Helmert.**
Veröffentlichung des Königl. Preussischen Geodätischen Institutes und Centralbureaus der Internationalen Erdmessung. Beiträge zur Theorie des Reversionspendels. Von F. R. Helmert. Potsdam, 1898. Size 11½ × 9½, pp. 92. *Plate.*

Geodesy—Gravity Observations. **Krüger.**
Veröffentlichung des Königl. Preussischen Geodätischen Institutes und Centralbureaus der Internationalen Erdmessung. Beiträge zur Berechnung von Lotabweichungssystemen. Von Prof. Dr. L. Krüger. Potsdam, 1898. Size 11½ × 9½, pp. iv. and 106.

Geographical Instrument. **Jäderin.**
Öfversigt. K. Vet. A. Förhand. Stockholm **54**, 1897 (1898): 493–505.
Nivåsextant, konstruerad för Andrées polarballong. Af Edv. Jäderin.

Description of a sextant fitted with a spirit-level, and intended for use without an artificial horizon.

Latitude.
Veröffentlichung des Königl. Preussischen Geodätischen Institutes. Die Polhöhe von Potsdam. 1 Heft. Berlin: P. Stankiewicz, 1898. Size 11½ × 9, pp. 140. *Diagram and Plans.*

A detailed account of the observations of the latitude of Potsdam Observatory, made with the highest precision in the investigation of the variation of latitude.

Longitude Determinations. *P.I. Civil Engineers* **133** (1898): 316–330. **Downes.**
The Determination of Longitude in Land Surveying. By R. H. B. Downes.

Specimens of the methods usually employed for determining longitude on land.

Nautical Astronomy. **Marcuse.**
Mittheilungen über neuer nautisch-astronomische Tafeln. Von Dr. Adolf Marcuse. (Sonder-Abdruck aus "Marine-Rundschau," 7 Heft, 1898.) Size 10 × 6½, pp. [8].

Time—Decimal Division. *Rev. Scientifique* **9** (1898): 804–808. **Sarrauton.**
Exposé du Systeme de l'Heure décimale. Par M. H. de Sarrauton.

Time Standards. *Rev. Scientifique* **9** (1898): 690–691. **Marcuse.**
L'heure nationale. Par M. E. Marcuse.

Time Standards. *Rev. G.* **43** (1898): 30–38. **Marsay.**
L'heure nationale. Par Vicomte R. de Marsay.

Arguments to show that it is undesirable to assimilate the legal time of France to that of the rest of Western Europe.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Coast-forms. *P.I. Civil Engineers* **133** (1898): 46–112. **Crosthwaite.**
The Stability of Channels through Sandy Estuaries. By Ponsonby Moore Crosthwaite. *With Illustrations.*

Geology. **Watts.**
Geology for Beginners. By W. W. Watts. London: Macmillan & Co, 1898. Size 7 × 5, pp. xviii. and 352. *Illustrations. Price* 2*s.* 6*d. Presented by the Publishers.*

This little book is particularly characterized by the admirable illustrations, many of them from geological photographs of great interest. It supplies what may be called the minimum of geology required by all geographers before the geographical features of any region can be understood.

Geomorphology. *Mém. S.G. Genève* **37** (1898): 45–86. **Girard.**
Études synthétiques sur la forme de la Terre. Par M. le Prof. Raymond de Girard.

A discussion of the knowledge of the ancients with regard to the form of the Earth, leading on to a summary of current theories as to the origin and precise form of the surface of the lithosphere.

Geomorphology. **Lapparent.**
Soulèvements et Affaissements. Par A. de Lapparent. Extrait de la *Revue des Questions Scientifiques*, juillet 1898. Louvain: Imp. Polleunis et Centerick, 1898. Size 10 × 6½, pp. 34. *Presented by the Author.*

A controversial paper dealing with the causes of differential crustal movement, and pointing out the evidence for the origin of rift valleys on the top of ridges raised by tangential thrust in opposition to the view that they arise from subsidence due to the withdrawal by volcanic outflow of subcrustal molten matter.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Commercial Geography. *Rendiconti R.A. Lincei* **7** (1898): 235–243. **Loria.**

Ricerche ulteriori sulla distribuzione topografica della industrie. Nota del Corrispondente Achille Loria.

A theoretical paper on the effect of distance between centres of production and of consumption of commodities.

Historical. ——

Beiträge zur Alten Geschichte und Geographie. Festschrift für Heinrich Kiepert. Berlin: Dietrich Reimer (Ernst Vohsen), 1898. Size 11 × 7½, pp. xiv. and 356. *Portraits, Maps, and Illustrations.*

A collection of twenty-seven memoirs on historical (mainly classical) geography, published in celebration of the eightieth birthday of Prof. Kiepert.

Historical—Map. **Magnaghi.**

La Carta Nautica costruita nel 1325 da Angelino Dalorto. Notizia di Alberto Magnaghi. Firenze: M. Ricci, 1898. Size 14 × 10, pp. 16. *Map. Presented by Principe Tommaso Corsini.*

A note on this paper will be given.

Historical—Toscanelli. *Mem. S.G. Italiana* **8** (1898): 138–154. **Uzielli.**

Colloquio avvenuto in Firenze nel Luglio 1459 fra gli ambasciatori del Portogallo e Paolo Dal Pozzo Toscanelli.

Historical—Vasco da Gama. ——

The Fourth Centenary of Vasco Da Gama's landing at Calicut. Celebrated on May 25, 1898, at Calicut. Calicut, 1898. Size 8½ × 5½, pp. 20.

Historical—Vasco da Gama. *B.S.G. Lille* **29** (1898): 401–425. **d'Avellar.**

Le Portugal et Vasco da Gama. Par M. le Dr. Éduardo d'Avellar. *With Map and Portrait.*

Notes on the historic growth of Portugal up to the era of discoveries, and a description of the chief Portuguese voyages.

BIOGRAPHY.

Banning. *Mouvement G.* **15** (1898): 355–358. **Wauters.**

Émile Banning. Par A. J. Wauters. *With Portrait.*

M. Banning took a prominent part in founding the International African Association, and in studying the history and political relations of West Africa.

Bouthillier de Beaumont. *Mém. S.G. Genève* **37** (1898): 1–14. **Claparède.**

Henry Bouthillier de Beaumont, Notice nécrologique. Par M. Arthur de Claparède. *With Portrait.*

M. Bouthillier de Beaumont was born in 1819, and died on February 4, 1898. He was an ardent student of geography, and the founder of the Geographical Society of Geneva.

Dronke. *Deutsche Rundschau G.* **20** (1898): 520–522. **Wolkenhauer.**

Dr. Adolf Dronke. Von W. Wolkenhauer. *With Portrait.*

Born 1837, died 1898; a teacher specially interested in methods of geographical instruction.

Garnier. *C. Rd. S.G. Paris* (1898): 285–292. ——

Inauguration du monument de Francis Garnier. *With Illustration.*

Johnson. **Bonwick.**

Australia's First Preacher; the Rev. Richard Johnson, First Chaplain of New South Wales. By James Bonwick. London: Low & Co. [1898.] Size 7½ × 5, pp. viii. and 264. *Presented by the Author.*

This biography is an interesting chapter in the first history of New South Wales.

Pöppig. *Deutsche Rundschau G.* **20** (1898): 518–519. **Wolkenhauer.**

Eduard Pöppig. Von W. Wolkenhauer. *With Portrait.*

Pöppig was born in 1798, and died in 1868. His work as a South American explorer is recalled in connection with the centenary of his birth.

GENERAL.

Ballooning. *Meteorolog. Z.* **15** (1898): 241–248. **Erk.**

Die erste Konferenz der internationalen aëronautischen Kommission. Von Fritz Erk.

Bibliography. **Wingate.**

Catalogue of Maps and Books in the Library of the Egyptian War Office. Accessions, 1894–1896. Prepared . . . by Lieut.-Colonel F. R. Wingate, C.B. London: Eyre & Spottiswoode, 1897. Size 10½ × 7½, pp. 12 and 38. *Presented by the Author.*

Educational—Methods. *G.Z.* **4** (1898): 431–454. **Müller.**

Die Bedeutung schematischer geologischer Profile für den Geographie-Unterricht an Mittelschulen. Von Prof. Johannes Müller. *With Profiles.*

A plea for the use of geological sections of a region in the teaching of geography, with examples illustrating the manner in which they may be employed. The proposal demands a knowledge of geology in excess of that usually found in school teachers.

Educational—Methods. *Naturw. Wochenschrift* **13** (1898): 373–381. **Schwalbe.**

Der achte naturwissenschaftliche Feriéncursus für Lehrer an höheren Schulen, abgehalten in Berlin vom Mittwoch den 13 April bis Sonnabend den 23 April 1898. Bericht auf Grund eingegangener Beiträge durch Prof. Dr. B. Schwalbe.

Discusses, amongst other things, the geographical instruction in the vacation lectures to teachers.

Educational—Text-Book. **Bird.**

A School Geography. By Charles Bird. London: Whittaker & Co., 1898. Size 7½ × 5½, pp. x. and 294. *Sketch-maps. Price* 2*s.* 6*d. Presented by the Publishers.*

This little book is designed on a satisfactory plan, and does not fall into the error, now somewhat common, of subordinating important details to vague generalities. It bears signs of careful compilation; but a future edition will naturally smooth away such inaccuracies as the statement that some rivers of the English Lake District are tributary to the Yorkshire Ouse, that Inveraray is the chief town on the west of Scotland, and the like.

Educational—Text-Book. **Herbertson.**

An Illustrated School Geography. By Andrew J. Herbertson. Partly based on Frye's "Complete Geography," and including most of its Illustrations and Photo-Relief Maps, supplemented by others. With Sixteen Pages of Coloured Maps. London: Edward Arnold, 1898. Size 12½ × 10, pp. viii. and 264. *Price* 5*s. Presented by the Publisher.*

A note on this book will be given in the Monthly Record.

Geographical Congress. **Magistris.**

L. F. de Magistris. Il terzo Congresso Geografico Italiano (Firenze 12–17 Aprile 1898). [Estratto dal Bollettino della Società Geografica Italiana, Fasc. vi., 1898.] Roma, 1898. Size 9½ × 6, pp. 30. *Presented by the Author.*

Geographical Paradox. **Campion.**

The Secret of the Poles. By Henry Campion. Illustrated by an original Physical Map of the Earth in Space: showing approximately the thickness of its crust, its complete hollowness, both polar openings, the Antarctic and Arctic atmospheres, the entrance of the ethereal meteoric matter, and both Auroras. Birmingham: White & Pike, 1898. Size 7½ × 5½, pp. 48. *Presented by the Author.*

An example of the curious results of the combination of ignorance with a vivid imagination.

Geographical Work. *J. Manchester G.S.* **13**, 1897 (1898): 189–202. ——

Conference of Missionaries on Geography.

The Manchester Geographical Society called together a congress of missionaries of all denominations, with a view to obtain their views and enlist their sympathies with regard to the carrying out of geographical work in connection with Christian missions. The proceedings, here published, contain some interesting speeches.

Geography. **Corcelle.**

La Géographie et l'education nationale. Par J. Corcelle. (Extrait de la *Revue de Géographie.* Numero de Juillet 1898.) Size 10 × 6½, pp. 8. *Presented by the Author.*

M. Corcelle protests against the tendency, of which he believes he recognizes

symptoms, to look on physical geography as the whole of geography. He deplores the reluctance of the French people to undertake distant travel.

German Colonies. **Whitehead and Rice.**

German Colonies, 1897. Foreign Office, Miscellaneous, No. 474, 1898. Size 10 × 6½, pp. 44. *Price* 2½*d.*

Health. **Romeril.**

[Course of Papers, No. 57.] Shipmasters' Society, London. Ninth Session. Quarantine: from a Shipmaster's point of view. By W. G. Romeril. London: Printed by Pewtress & Co., 1898. Size 8½ × 5½, pp. 56.

Health. **Sambon.**

Remarks on the Etiology of Sunstroke (Siriasis): not heat fever, but an infectious disease. By L. Westenra Sambon, M.D. (Reprinted . . . from the *British Medical Journal*, March 19, 1898.) Size 8½ × 5½, pp. 12. *Presented by the Author.*

NEW MAPS.

By J. COLES, *Map Curator*, R.G.S.

EUROPE.

England and Wales. **Ordnance Survey.**

Publications issued since September 8, 1898.

1-inch—General Maps:—

ENGLAND AND WALES (revision):—39, 49, 60, 61, 91, 121, 145, 245, 266, 276, 295, 311, 326, engraved in outline; 95, 249, 263, 266, 297, 298, 307, 313, 342, hills engraved in black and brown. 1*s.* each.

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25-inch—Parish Maps:—

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MISCELLANEOUS:—One-inch Parish Indexes, printed in colours, showing 25-inch parish maps only: Sheets 205, 206, 239, 240, 241, 242, 258, 259, 272, 273, 289, 290, 305, 314. *Price* 1*s.* each. These are also published showing 6-inch quarter-sheets only, *price* 1*s.* each.

(*E. Stanford, Agent.*)

Germany. **Königl. Preuss. Landes-Aufnahme.**

Karte des Deutschen Reiches. Herausgegeben von der Kartogr. Abtheilung der Königl. Preuss. Landes-Aufnahme 1897. Scale 1 : 100,000 or 1·5 stat. miles to an inch. Sheets: 280, Getelomoor; 322, Züllichau; 328, Bocholt; 404, Solingen. *Price* 1.50 *marks each sheet.*

ASIA.

Central Asia. **Petermann's Geographische Mitteilungen.**

Profil durch das Flussbett des Amudarja bei Tschardschui. (Russiche Originalaufnahme.) Petermann's Geographische Mitteilungen, Jahrgang 1898, Tafel 15. Gotha: Justus Perthes. *Presented by the Publisher.*

Indian Government Surveys. **Surveyor-General's Office, Calcutta.**

Indian Atlas, 4 miles to an inch. Quarter-Sheets: 1 N.E., parts of districts Shikarpur, Kurrachee and Hyderabad, and Khairpur Native State (Sind, Bombay Presidency), additions to 1895; 11 N.E., part of district Thar and Párkar (Sind, Bombay Presidency); 11 N.W., parts of districts Hyderabad, Kurrachee and Thar, and Párkar (Sind, Bombay Presidency), additions to 1895; 24 N.E., parts of districts Surat, Thána, and Nasik, and of Dharampor, Bansdá, Jawhár and Surgána States (Bombay Presidency), and Daman (Portuguese Territory), 1898; 31 S.E. parts of districts Hissar and Ferozepore, and Native States of Patiala (Punjab), and Bickaneer (Rajputana Agency), additions to 1896; 35 N.E., parts of Native States Gwalior and Indore (Central India Agency), and of Oodeypore, Tonk, Boondee, and Jhallawar (Rajputana Agency), Additions to 1895; 36 N.E., parts of Banswara, Partabgarh (Rajputana Agency, Native States), Gwalior, Jaora, Rutlam, Sailand, Indore, Dewas, Jhabua, Bori and Dhar (Central India Agency, Native States), additions to 1895; 37 N.E., parts of districts Khandesh (Bombay Presidency), and Nimar (Central Provinces), and of Native States Indore, Gwalior, Dhar, and Barwani (Central India Agency), additions to 1892; 39 S.E., parts of districts, Sholapur, Admednagar, Poona, and Satara (Bombay Presidency); Naldurg and Bid (Nizam's dominions), additions to 1896; 49 N.E., parts of districts Moradabad, Meerut, Muzaffarnagar, and Bijnor (N.W. Provinces), Delhi, and Karnal (Punjab), additions to 1896; 61 S.E., parts of districts Coimbatore, Nilgiri, Salem, and Madura (Madras Presidency), 1898; 89 S.E., parts of district Mirzapur (N.W. Provinces), Native State of Rewah (Central India Agency), Cháng Bhakár, Koria, and Sargúja of Garhját States (Bengal); 127 S.E., parts of districts Chittagong (Bengal) and Akyab (Lower Burma), additions to 1887. Sheets: 88, districts Jaunpur and parts of districts Allahabad, Azamgarh, Benares, Fatehpur, Mirzapur, and Banda (N.W. Provinces), districts Rae Bareli, Partabgarh, and Sultanpur (Oudh); 94, parts of districts Khamamet (Nizam's dominions), of Kistna, Godavari, and Vizagapatam (Madras Presidency), and Bastar State (Central Presidency).—Bombay Survey, 1 inch to a mile. No. 192, district Nasik, Season 1871–1874. — Upper Burma Survey, 1 inch to a mile, Seasons 1891 to 1893. Sheets 89, 90, and 130. District Minbu. Sheet 314, Southern Shan States, Season 1894–95.—Lower Burma Survey, 1 inch to a mile. Sheets 371 (Preliminary Edition) and 476, District Thaton, Seasons 1894–96. — Central India and Rajputana Survey, 1 inch to a mile. Sheet 312, parts of district Gurgaon and Nabha Native State (Punjab) and of Ulwur and Jeypore Native States (Rajputana Agency). Seasons 1848–49–62.—Gujaret, 16 miles to an inch, 1898.—District Darjeeling, Lower Provinces, Bengal, 4 miles to an inch, Seasons 1861–67.—District Backergunge, Lower Provinces, Bengal, 4 miles to an inch, with additions to 1896.—District Bálaghát, Central Provinces, 12 miles to an inch, 1898.—District Dera Ismail Khan, Punjab, 16 miles to an inch, 1898.—District Ludhiána, Punjab, 16 miles to an inch, 1898.—District Wardha, Central Provinces, 8 miles to an inch, 1897.—District Delhi, Punjab, 8 miles to an inch, 1898.—District Bogra, Bengal, 8 miles to an inch, 1890.—District Cuttack, Bengal, 1890.—District Hazáribágh, 8 miles to an inch, 1894.—District Saugar, Bengal, Central Provinces, 8 miles to an inch, 1897.—District Bhandára, Central Provinces, 8 miles to an inch, 1898.—District Karnal, Punjab, 8 miles to an inch, 1898.—Chart of Triangulation, No. 12 Party (Sind), Sheet No. 17 (Sind), 2 miles to an inch, Season 1895–96. *Presented by H.M. Secretary of State for India, through the India Office.*

AFRICA.

West Africa. **Frobenius.**

Der westafrikanische Kulturkreis. Von L. Frobenius. *Petermann's Geographische Mitteilungen*, Jahrgang 1898, Tafel 14. Gotha: Justus Perthes. *Presented by the Publisher.*

AMERICA.

Canada. **Johnston.**

Map of the Dominion of Canada. Scale 1: 5,070,000 or 80 stat. miles to an inch. W. & A. K. Johnston, Edinburgh and London, 1898. *Presented by the Publishers.*

This map has been produced in a bold style, suitable for schools.

United States. **Gannett.**

Statistical Atlas of the United States, based upon results of the Eleventh Census. By Henry Gannett. Published by the Department of the Interior, Washington, 1898. *Presented by the Secretary, U.S. Department of the Interior.*

This atlas, which has been compiled from the statistics of the United States eleventh census, under the supervision of Prof. Henry Gannett, is the joint product of many men and many minds. All matters relating to population, with the classification by race, nativity, sex, age, conjugal condition, occupation, illiteracy, education, and religion; dependent, defective, and delinquent classes; industries of agriculture, manufactures, and mining, have been prepared by Prof. H. Gannett. The numerous diagrams and maps relating to mortality have been prepared under the direction of Dr. J. S. Billings; those having reference to transportation by Prof. H. C. Adams; those dealing with wealth, debt, and taxation by Mr. J. K. Upton; and those relating to mortgage, indebtedness under the direction of Mr. G. K. Holmes.

This atlas contains maps and diagrams illustrating all the above subjects; these are so clearly drawn that they show at a glance their exact state in 1890, the date at which the last census was taken. Considering the vast amount of carefully compiled statistical information which this excellent atlas contains, and the evident care with which the maps and diagrams have been prepared, it is no matter for astonishment that so long a period should have elapsed before its appearance.

GENERAL.

Educational. **Pennesi.**

Atlante Scolastico per la Geografia Fisica e Politica di Giuseppe Pennesi. Istituto Cartografico Italiano, Roma, 1898. *Price li* 7.50.

This is a new edition of this atlas. Some alterations and additions have been made to bring it up to date, and the manner in which political and physical maps have been arranged is worthy of special commendation.

World. **Johnston.**

The Naval League Map, illustrating British Naval History. W. & A. K. Johnston, Edinburgh and London, 1898. *Price* £1 1*s*. *Presented by the Publishers.*

This map is drawn in a bold style, and is not overcrowded with names. The map is specially intended to illustrate British naval history. All the principal political boundaries are laid down, the positions of coaling-stations are indicated, and the limits of the British naval stations are shown. By referring to a table on the map, the positions of all the great British naval battles can be found, in addition to which a considerable amount of information in connection with British naval influence and power is given in tabulated form.

World. **Andree.**

Andrees allgemeiner Handatlas, 126 Haupt- und 130 Nebenkarten auf 186 Kartenseiten, nebst alphabetischem Namenverzeichnis. Vierte, völlig neubearbeitete, stark vermehrte Auflage, herausgegeben von A. Scobel. Bielefeld und Leipzig: Verlag von Velhagen and Klasing, 1898.

Lief 30, Frankreich, Südliche Hälfte; Ostchina und Korea; Japan.—Lief 31, Asiatische Türkei; Vereinigte Staaten von Nordamerika.—Lief 32, Europa, Politische Übersicht; Agypten und Nubien; Kapland, Natal, und Burenrepubliken Lüderitzland.—Lief 33, Europa, Niederschlagsmengen und Volksdichte; Deutschland, Physische Übersicht.

World. **Bartholomew.**

The Citizen's Atlas. One hundred maps and gazetteer. By J. G. Bartholomew, F.R.G.S. Published by George Newnes, Ltd., London. To be completed in 20 parts, issued fortnightly. Parts 15 and 16. *Price* 6*d. each.*

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, during July and August, 1898. *Presented by the Hydrographic Department, Admiralty.*

No.	Inches.	
1828	m = 2·0	England, south-east coast:—The Downs. 2*s.* 6*d.*
1553	m = 6·8	Orkney islands, Kirkwall bay. 1*s.* 6*d.*
2966	m = 8·6	Lapland:—Port Ekaterininskoi and Pala bay. 2*s.*
2968	m = var.	Plans on the north coast of Russian Lapland:—Inner Teriberskoi bay, Podpakhta bay, Voroni and Gavrilova bays. 1*s.* 6*d.*
2969	m = 3·0	Plans in the White sea:—Kandalaksha approaches. 1*s.* 6*d.*
1515	m = 0·42	Portugal:—Burling island to Cape Espichel, including the approaches to the River Tagus. 2*s.* 6*d.*
2996	m = 0·5	Black sea:—Karkinitskago bay. 1*s.* 6*d.*
3006	m = var.	Anchorages and harbours on the north-west side of the Great Bahama bank:—Great Isaac anchorage, Dollar harbour, South Cat cay, Bemini islands, Barnett harbour, Gun cay anchorage, Riding rock anchorage. 1*s.* 6*d.*
522	m = 1·8	British Honduras:—Belize harbour. 2*s.* 6*d.*
3005	m = 1·8	Gulf of Mexico:—Tortugas harbour and approaches (plan, Tortugas harbour). 1*s.* 6*d.*
1673	m = 3·0	Plans on the coast of Brazil:—Jacuacanga bay. 1*s.* 6*d.*
837	m = 7·2	Anchorages in south-east Alaska:—Karta bay. 1*s.* 6*d.*
2288	m = 0·9	Alaska:—Lynn canal from point Sherman to head of inlet. 2*s.* 6*d.*
1668	m = 6·0	Anchorages on the Gold coast:—Accra, Appam. 1*s.* 6*d.*
123	m = 24·5	Africa, south coast:—Table bay breakwater and docks. 2*s.*
1641	m = 3·9	Harbours and anchorages on the coast of Formosa:—Toko Hakuchi. 1*s.* 6*d.*
1084	m = var.	Plans on the north-east coast of New Guinea:—Astrolabe bay, Port Constantine, Port Grand Duke Alexis, Finsch harbour, Friedrich Wilhelm and Prinz Heinrich harbours. 1*s.* 6*d.*
2238		Plan added:—Sungul bay.
581		Plan added:—Vere cove.
1449		Plan added:—Port Conclusion.
685		New Plan:—Limpopo river entrance.
1810		Plan added:—Angoche port and bar.
302		Plans added:—Entrance to the Koppi river, entrance to the Nelma river, entrance to the Luda river, entrance to the Ademi river, entrance to the Toropuichina river, Plitnyak bay, entrance to the Svyetloi river.
1730		Plans added:—Afono bay, Falealili harbour.

(*J. D. Potter, Agent.*)

Charts Cancelled.

No.		Cancelled by	No.
1828	The Downs.	New chart. The Downs	1828
522	Belize harbour.	New Chart. Belize harbour	522
525	Plan of Tortugas harbour on this chart.	New Chart. Tortugas harbour and approaches	3005
123	Table bay breakwater and docks.	New Chart. Table bay breakwater and docks	123
1084	Plans on the north-east coast of New Guinea.	New Chart. Plans on north-east coast of New Guinea	1084

Charts that have received Important Corrections.

No. 2598:—The World, showing curves of equal variation. 1975, River Thames:—Kentish Knock to the West Swin. 1753, Ireland, east coast:—Belfast lough. 2327, Norway:—The Naze to Christiansand. 2260, Ports on the south coast of Norway. 2281, Norway:—The Naze to Karmö. 2317, Norway:—Tana fiord to Varanger fiord. 2272, White sea:—Kouzminskia hills and Cape Voronov to Nikodimskoi point and river Ruchi. 2275, White sea:—Gulf of Onega. 2256, Gulf of Riga:—River Dvina. 2613, France, north coast:—Cape Levi to Fécamp. 2835, Black sea:—Delta of the Danube. 565, Iceland, western portion. 566, Iceland, eastern portion. 2240, Iceland:—Approaches to Grundar and Kolgrafa fiords. 2976, Iceland:—Snefells Jökel to North Cape. 2733, Iceland:—Portland to Snefells Jökel. 2172, Bering strait. 285, Newfoundland:—Orange bay to Gander bay. 1452, Bahamas:—Nassau harbour. 525, Gulf of Mexico:—Boca Grande cay to Tortugas cays. 891, South America, east coast:—Pernambuco to Maceio. 530, South America, east coast:—Victoria to Santa Catharina. 85, Chile:—English

narrows, etc. 660, Central America, west coast:—Corinto harbour. 579, British Columbia:—Strait of Georgia, Sheet I., Frazer to north-east point of Texada island, etc. 584, British Columbia:—Sydney inlet to Nitinat. 569, British Columbia:—Esperanza to Clayoquot. 1923A, British Columbia:—Cape Caution to Port Simpson, etc., northern portion. 2110, Anchorages in south-east Alaska. 2462, Alaska:—Windham bay to Icy cape. 608, Africa, west coast:—River Gambia entrance. 2812, Africa, west coast:—Lagos harbour. 1806, Africa, west coast:—Great Fish bay to Walfisch bay. 632, Africa, west coast:—Walfisch bay to Orange river. 1843, Africa south coast:—Buffalo river. 2908, Africa, south coast;—Port Natal entrance. 164, Red sea:—Massawa channel. 2760, Sumatra, west coast:—Acheh head to Tyingkok bay. 932, Harbours and anchorages on the coast of Java. 1965, Cochin China:—Kua Lacht to Kao Tao shan islands. 775, Cochin China:—Approaches to Haifong. 854, China, south coast:—Port Swatau. 1763, China, east coast:—Wen-chau port and approaches. 1601, China:—Wusung river or Hwang pu. 128, Japan:—Channels between Bingo Nada and Ozuchi sima. 2923, Australia, east coast:—Hope islands to Turtle group, etc. 2766, North-east coast of New Guinea, etc. 2460, North Pacific ocean:—Kamchatka to Kadiak island. 191, Solomon islands:—Mboli harbour. 2658, Solomon islands:—Gavutu and Tulage harbours.

(*J. D. Potter, Agent.*)

PHOTOGRAPHS.

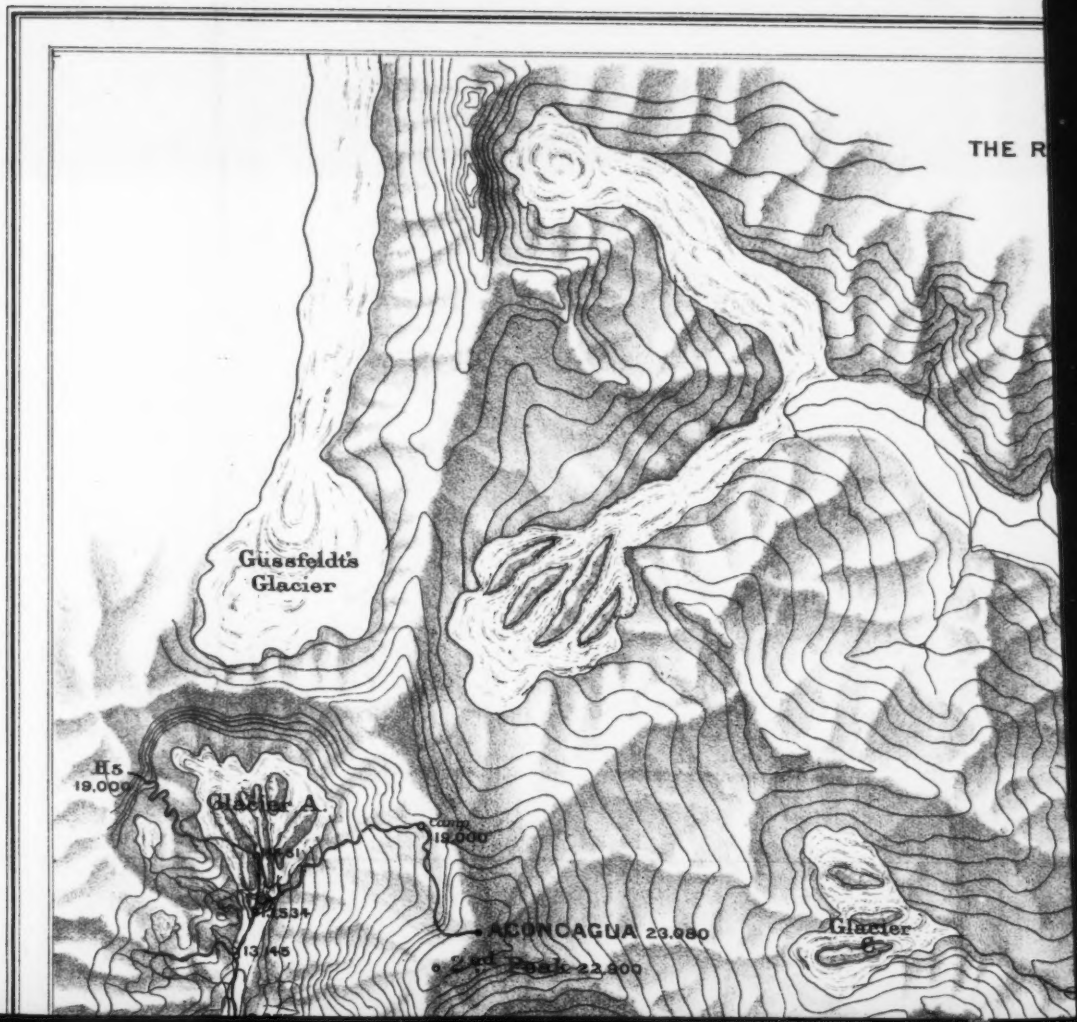
New Guinea and Northern Queensland. **Guise.**

Fifty-nine Photographs of New Guinea and Northern Queensland, taken by R. E. Guise, Esq. *Presented by R. E. Guise, Esq.*

As will be seen by the titles below, the majority of these photographs are of anthropological interest. They form a useful series, and are a valuable addition to the Society's collection.

(1) Bulaa girl in ordinary dress; (2) Cape Grenville aboriginal (Australia); (3) Cape Grenville (Australia) native; (4) Saroa girl; (5) Saroa girl; (6) Bulaa warrior in fighting dress; (7) Bulaa girls in dancing dress; (8) Divorced women, Bulaa; (9) Kalo village; (10) Kalo girl in dancing dress; (11) Native Mission teacher with wife and child; (12) Bulaa warriors; (13) Dancing at Bataka; (14) Bataka village; (15) Bataka feast; (16) Bulaa girls with ornaments worn at dances; (17) Chief's daughter with attendant, Bulaa; (18) Chief's daughter, Bulaa; (19) House-canoe, Bulaa; (20) Bulaa; (21) House-boat, Bulaa; (22) Scene near Mount Elmore; (23) Scene near Mount Elmore; (24) Scene near Mount Elmore; (25) Kalo dancing-girl; (26) Scene at Kalo; (27) Koogi, or sacred house; (28) Male dancers, Hood point; (29) [illegible]ers of the dance, Hood point; (30) Types of physique, Kamali, Hood point; (31) Part of Bulaa village, Hood point; (32) Babaka village, Hood point; (33) Babaka, Hood point; (34) Kamali girls; (35) Kamali girl; (36) Types of men, Kamali, Hood point; (37) Kamali, making roofing; (38) Bulaa, Hood point, girls in dancing-dress; (39) Irupara girl carrying water; (40) Scene at feast, Kamali; (41) Types of physique, Irupara; (42) Irupara girls; (43) Dancers, Koolupu; (44) Natives at Koolupu; (45) Koolupu, mountain village; (46) Return from market, Irupara; (47) Keakalo; (48) Keapara boy with pots; (49) Keakalo trading-canoe; (50) Part of feast, Kalo; (51) Exposition of sugar-cane at annual feast at Kalo, Hood point; (52) Part of feast at Kalo; (53) Trading Kebo, by canoe; (54) Cooking pork at feast, Kemali; (55) Native policeman and wife; (56) Scene at Waikunina, Kemp Welch river; (57) Scene at Waikunina, Kemp Welch river; (58) Scene at Waikunina, Kemp Welch river; (59) Tapu, staging for suspension of bananas, etc., in front of chief's house at annual feast (Kapa).

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.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Camp
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ACONCAGUA 23,080
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Glacier
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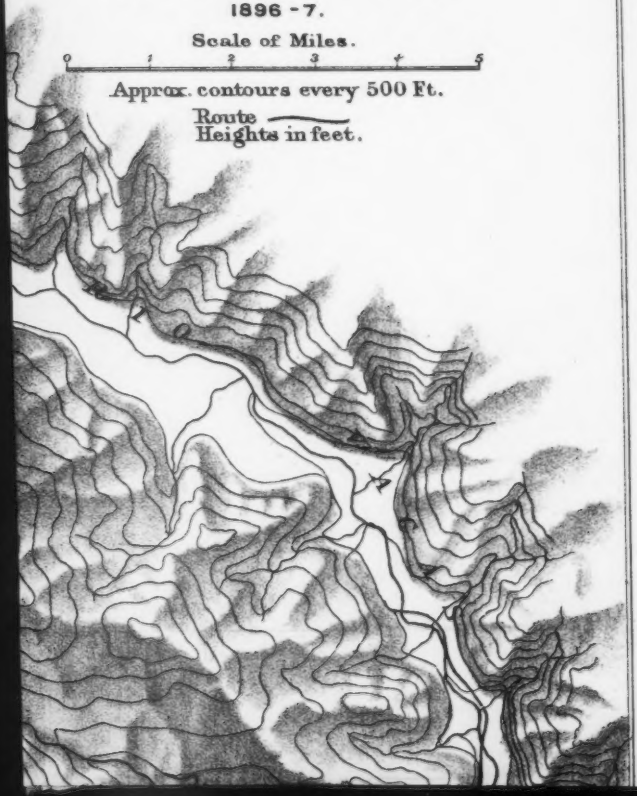
SKETCH MAP
to illustrate
HE ROUTE OF THE FITZGERALD EXPEDITION
TO
ACONCAGUA.
1896-7.



ACONCAGUA 23,080
2nd Peak 22,800
Glacier
Glacier B.
Almacenes
18,902
Tortoga
Horcones R.
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Horcones Peak
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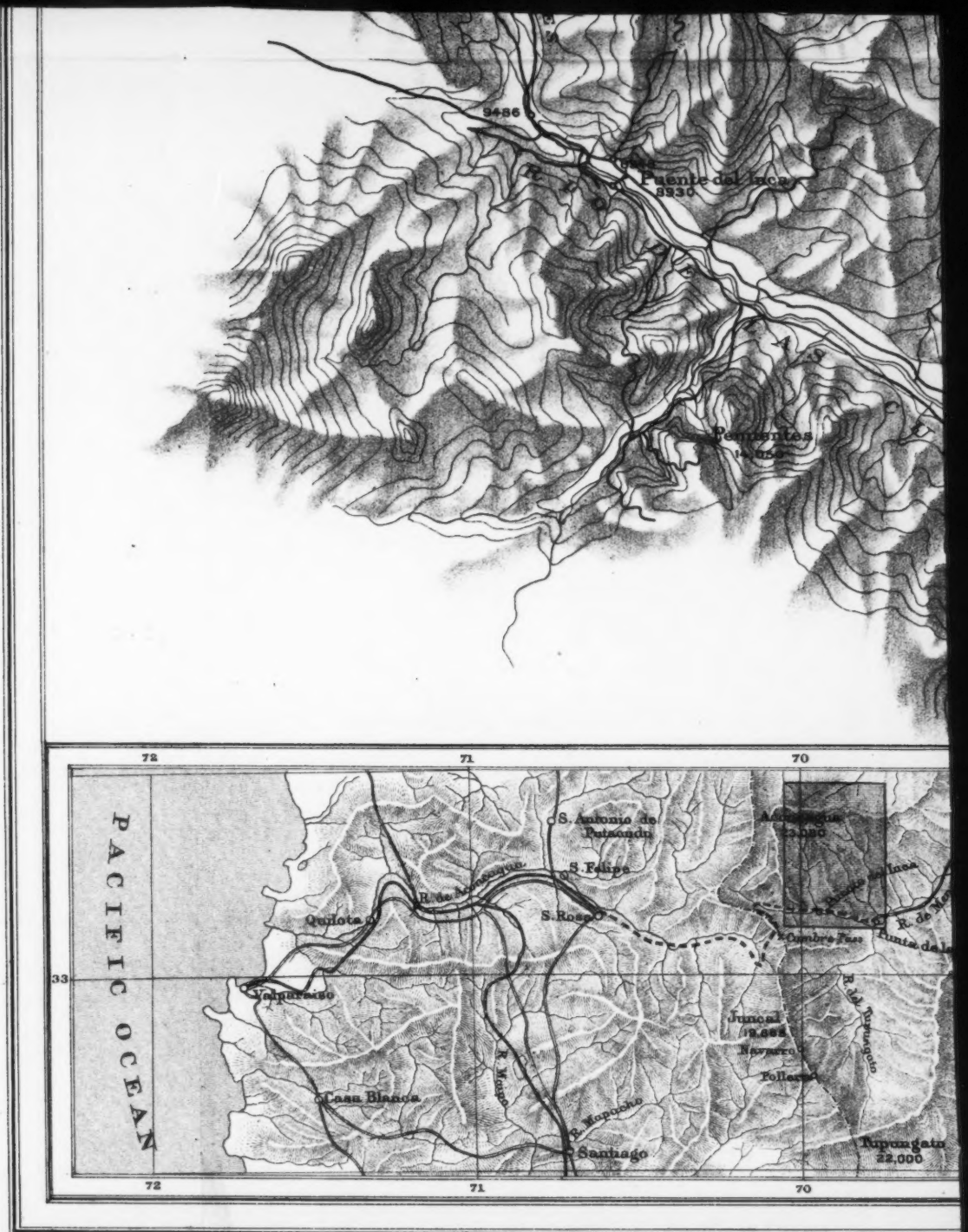

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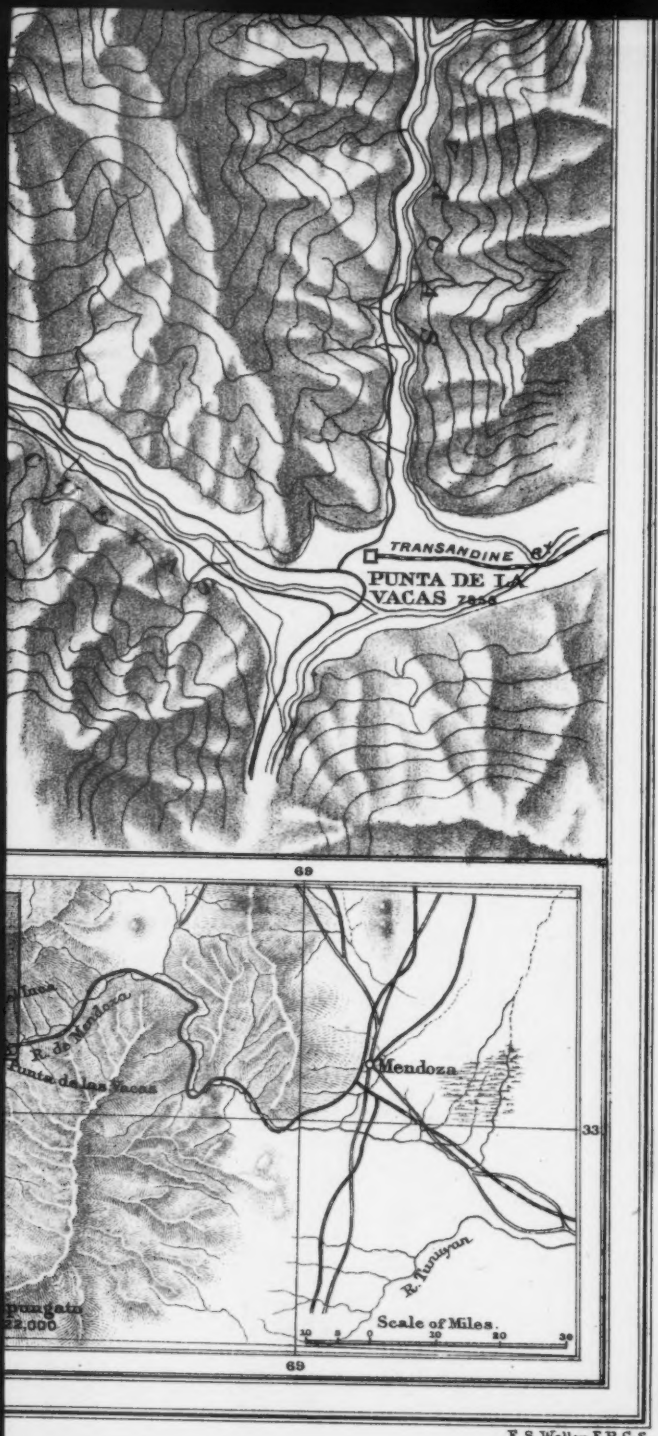
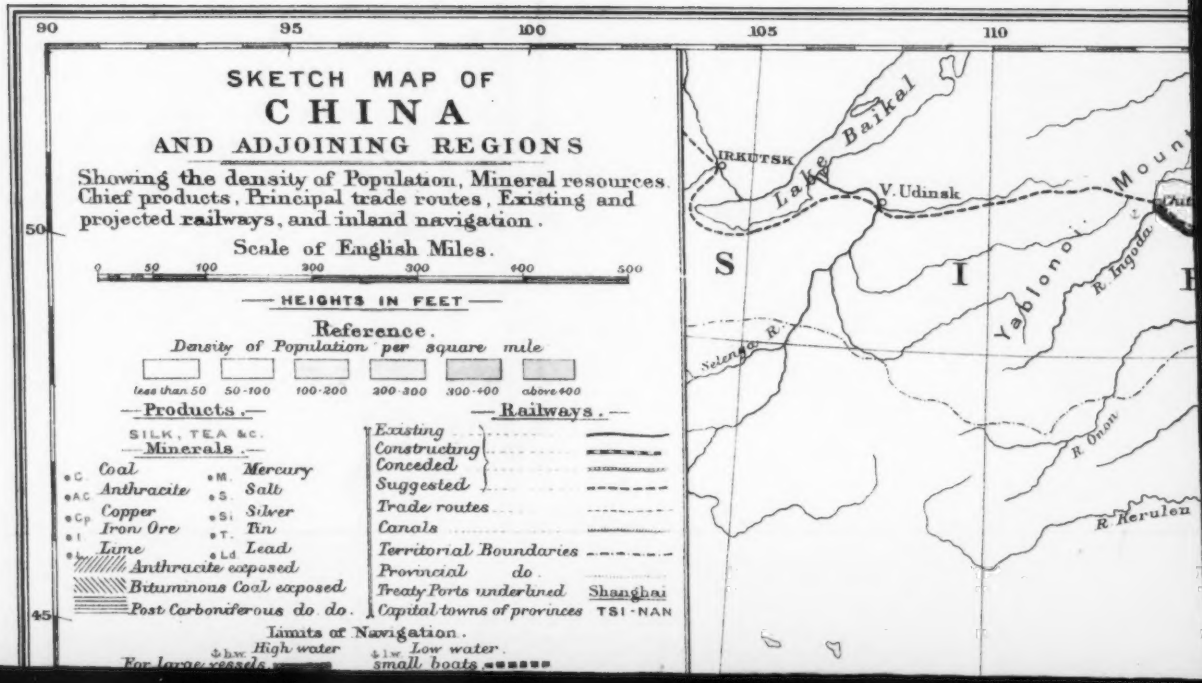
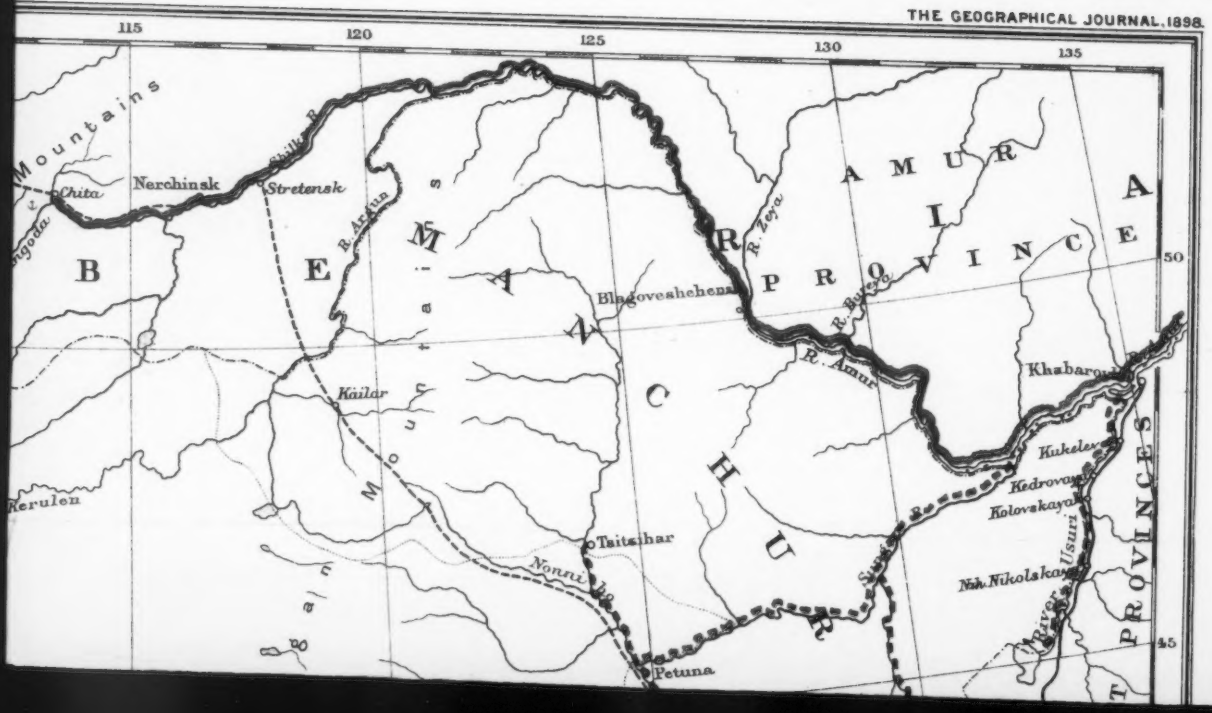
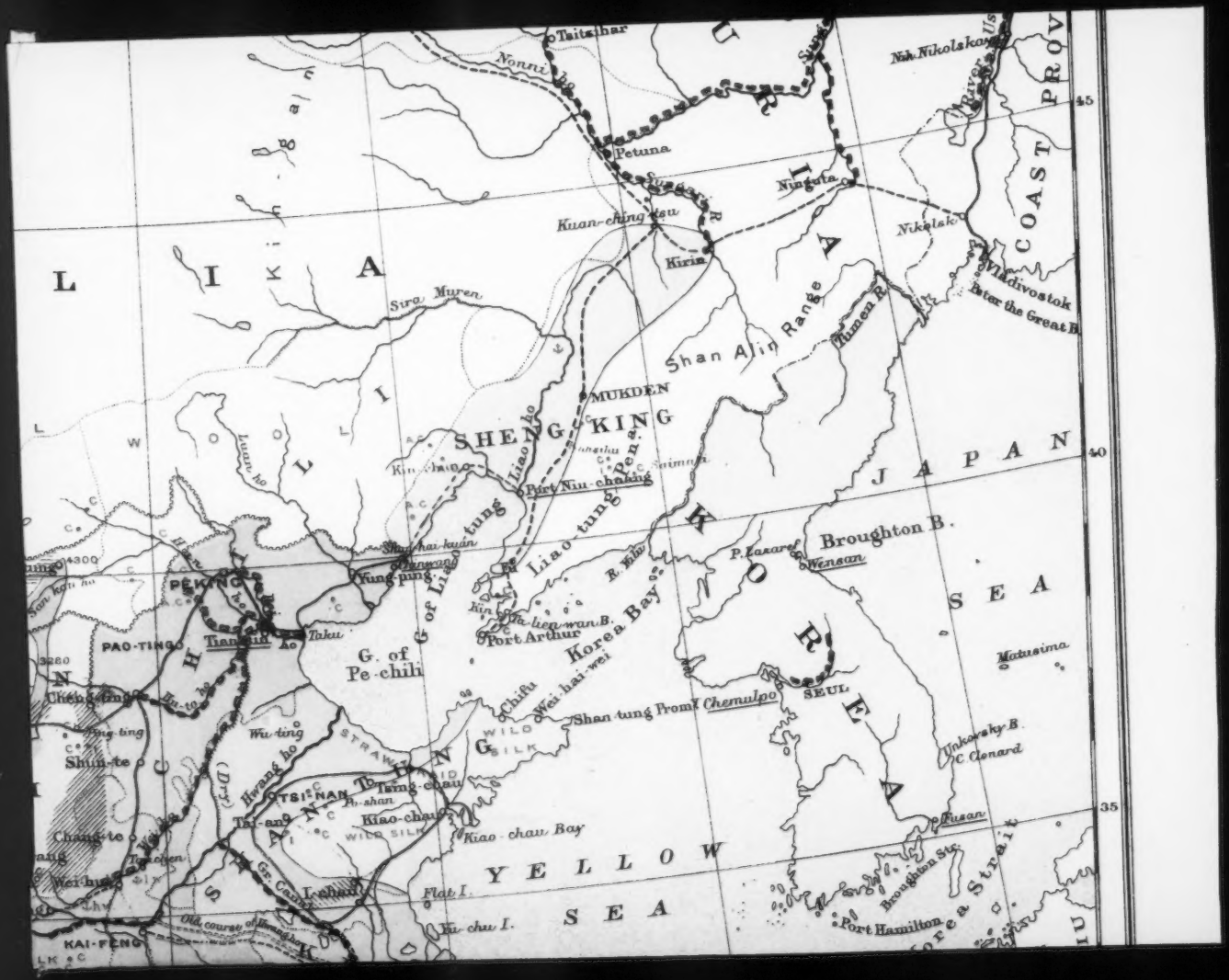


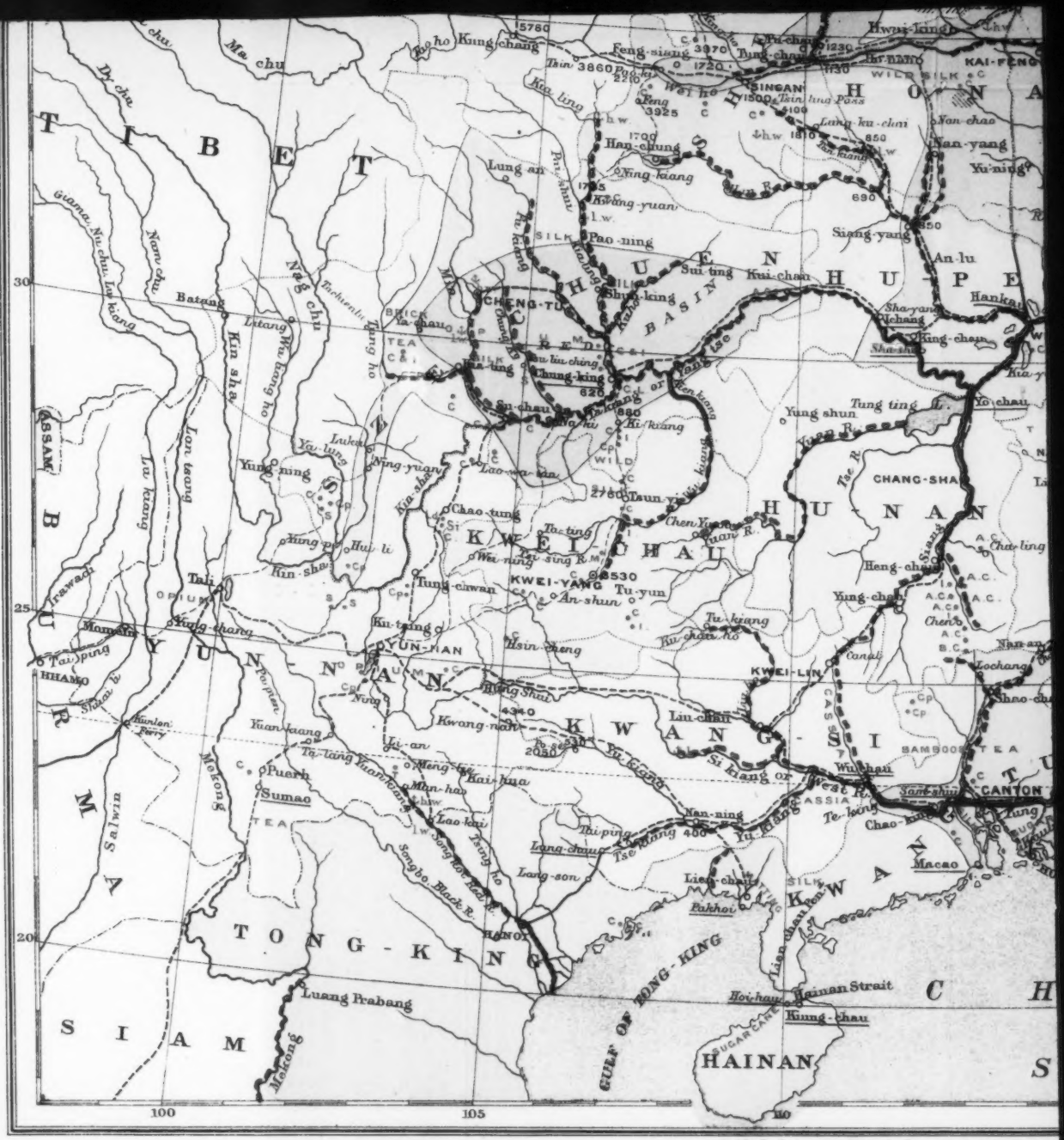
F.S.Weller, F.R.G.S.


90
95
100
105
110
50
45
SKETCH MAP OF
CHINA
AND ADJOINING REGIONS
Showing the density of Population, Mineral resources. Chief products, Principal trade routes, Existing and projected railways, and inland navigation.
Scale of English Miles.
0 50 100 200 300 400 500
HEIGHTS IN FEET
Reference.
Density of Population per square mile
less than 50
50-100
100-200
200-300
300-400
above 400
Products.
SILK, TEA &c.
Minerals.
C. Coal
AC. Anthracite
Cp. Copper
I. Iron Ore
L. Lime
M. Mercury
S. Salt
Si. Silver
T. Tin
Ld. Lead
Anthracite exposed
Bituminous Coal exposed
Post Carboniferous do do.
Railways.
Existing
Constructing
Conceded
Suggested
Trade routes
Canals
Territorial Boundaries
Provincial do.
Treaty Ports underlined Shanghai
Capital towns of provinces TSI-NAN
Limits of Navigation.
⚓hw. High water
For large vessels
⚓lw. Low water.
small boats
IRKUTSK
Lake Baikal
V. Udinsk
S
I
R. Ingoda
Yablonoi
Nelenga R.
R. Onon
R. Kerulen


115
120
125
130
135
50
45
Mountains
Chita
Nerchinsk
Stretensk
Shilka R.
R. Argun
R. Zeya
R. Bureya
R. Amur
Blagoveshchensk
Khabarovsk
Kukelevo
Kedrovaya
Kolovskaya
Nik. Nikolskaya
R. Usuri
Taitsihar
Nonni R.
Petuna
Kerulen
Kailar
Mountains
AMURIA PROVINCE
MANCHURIA
PROVINCES

Lime
Lead
Anthracite exposed
Bituminous Coal exposed
Post Carboniferous do. do.
Territorial Boundaries
Provincial do.
Treaty Ports underlined Shanghai
Capital towns of provinces TSI-NAN
Limits of Navigation.
H.w. High water
L.w. Low water.
For large vessels
small boats
45
40
35
MONGOL
Barkul
Hami
In-shan Range
WOOL
Anxi 3750
Su-chau 5060
Kan-chau 4800
Pass 6450
Liang-chau 5130
7050
Koko Nor
Sining 5940
KANSU
Hwang ho
4840
LAN-CHAU
5800
6200
7250
6625
8840
8550
Ping-han
King yang
Lungmen
Charing nor
Orong nor
Ye chu
Ma chu
Kung-chang
5780
Feng-siang 3370
Tsin 3860
1720
2210
Tung-chau 1230
Hwui-ling
KAI-FE
WILD SILK
Banta
Hwang ho
ORDOS
Ning-hia
GREAT WALL
Ta-ung 4300
SHAN
TAI-YUEN 2800
Yen-chang
Yen-an
SI
Ping yang
Wei-hui


Taitsihar
Nonni ho
Petuna
Kuan-ching-tsu
Kirin
Sira Muren
Shan Alin Range
Tumen R.
Nik. Nikolskoye
Ussuri R.
Nikolsk
Vladivostok
Peter the Great B.
COAST PROV.
Ninguta
MUKDEN
SHENG KING
Liao ho
Liao-tung Gulf
Liao-tung Peninsula
Port Niu-chwang
Shan-hai-kuan
Yung-pung
PEKING
Tientsin
Taku
PAO-TING
G. of Pe-chili
Kin-chau
Ta-lien-wan B.
Port Arthur
Korea Bay
Chefu
Wei-hai-wei
Shan-tung Promt.
Wu-ting
Hwang ho (Dry)
TSI-NAN
Tsing-chau
Tai-an
Kiao-chau
Kiao-chau Bay
Chang-te
Wei-hui
Gr. Canal
I-chau
Flat I.
Yu-chu I.
KAI-FENG
Old course of Hwang ho
YELLOW SEA
JAPAN
KOREA
Broughton B.
P. Lazarev
Wensan
SEA
Matusima
Chemulpo
SEUL
Unkovsky B.
C. Clonard
Fusan
Broughton Str.
Port Hamilton
Korea Strait
45
40
35


TIBET
HONAN
HUPEH
SZECHUEN
BASIN
KWEICHAU
HUNAN
YUNNAN
KWANGSI
KWANGTUNG
BURMA
ASSAM
SIAM
TONG-KING
HAINAN
CHENG-TU
SINGAN
KAI-FENG
CHANG-SHA
KWEI-YANG
YUN-NAN
CANTON
Macao
Hainan Strait
GULF OF TONG-KING
Luang Prabang
Mekong
Salwin
Irawadi
Momein
Bhamo
Sumao
Puerh
Batang
Litang
Tali
Yung-ning
Yung-chang
Kin-sha
Lan tsang
Lon tsang
Nag chu
Nan chu
Ma chu
Ta chu
Giama Nu chu
Lu kiang
Ya-lung
Yung-ning
Lao-ya-kan
Chao-tung
Ta-ting
Wei-ning
Tung-chwan
An-shun
Tu-yun
Ku-tsing
Yun-nan
Kwang-nan
Yuan-kiang
Ta-liang
Meng-tse
Kai-hua
Lao-kai
Song-koi or Red R.
Tsing ho
Lang-chuan
Lang-son
Pakhoi
Nan-ning
Yu-kiang
Tsi-kiang
Si kiang or West R.
Wu-chau
Sam-shui
Te-kiang
Chao-king
Kung-chau
Hoi-hau
Lien-chau
Yu-chau
Yung shun R.
Tung ting L.
Yuan R.
Chen R.
Yuan kiang
Yuan or Yen kiang
Kia-ling
Min kiang
Pai-shui
Han-chung
Ying-kiang
Kwang-yuan
Pao-ning
Su-ting
Kui-chau
Shun-king
Chung-king
Kia-ting
Kia-ching
Su-chau
Ki-kiang
Lao-ya-kan
Taun-yi
Wei-kiang
Kin-sha

phical Society.

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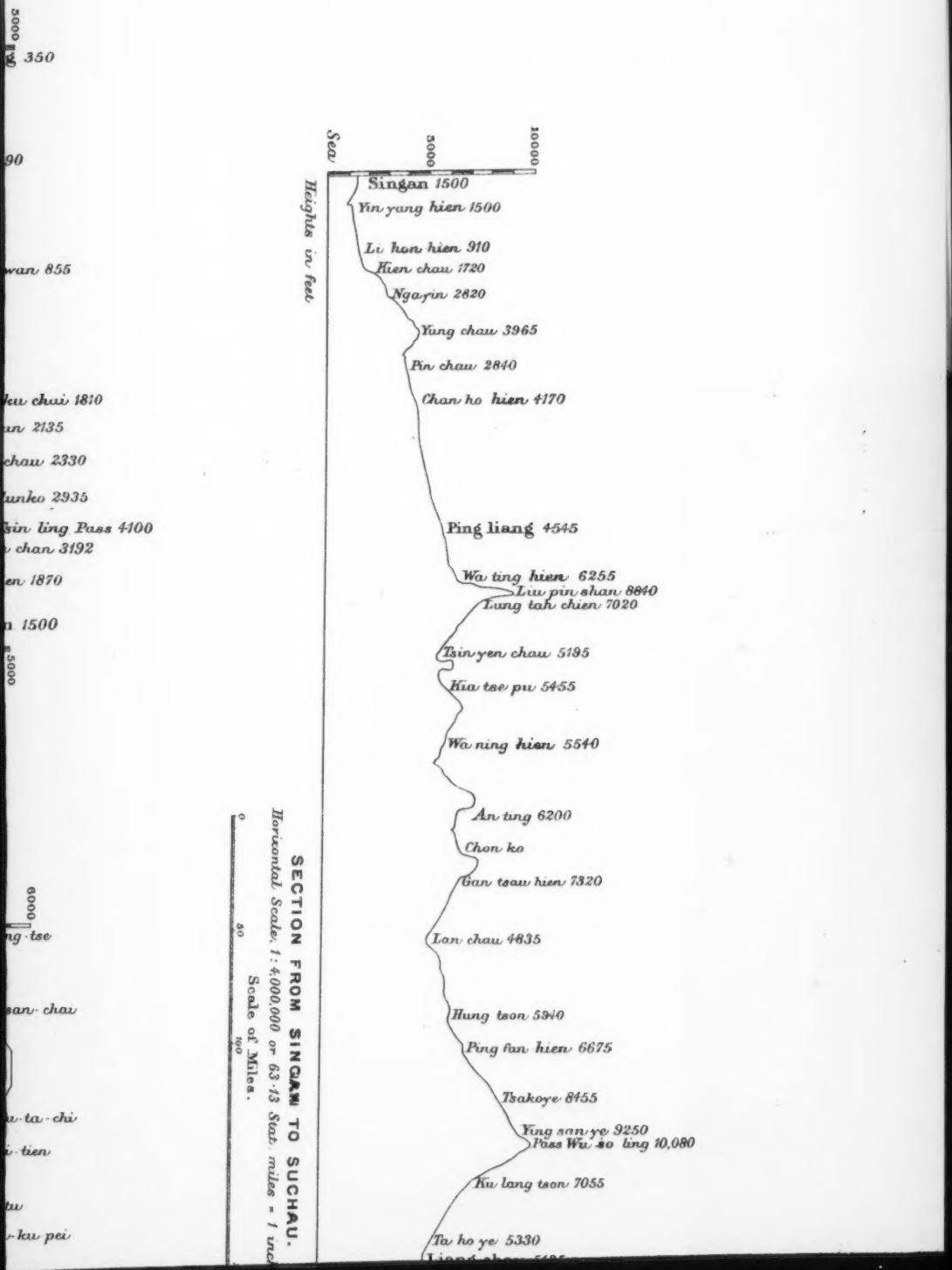
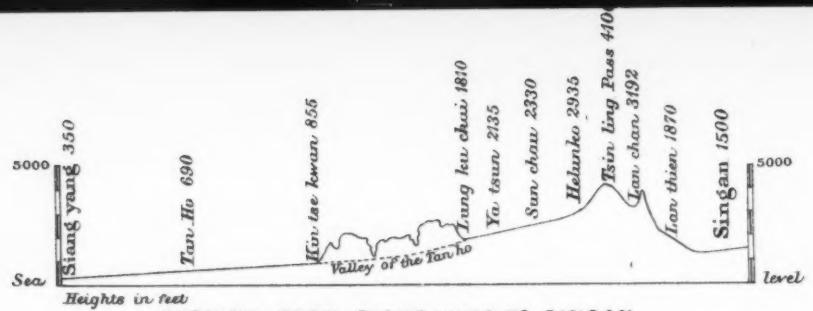


SECTION FROM SINGAN TO SUCHAU.

Horizontal Scale, 1:4,000,000 or 63·13 Stat. miles = 1 inch

AU.
1 inch.
203
6000
8000
Tu ho ye 5330
Liang chau 5135
Fung lo pu 5650
Yang shan hien 6455
Tsai hu tse 7745
Pass 8755
Sako 7680
Sing hoye 7045
Fung lo hien 5255
Kan chan 4805
Tsa hoye 4870
Kau ta hien 4660
Cho yan tse 4480
Yu tan ye 4670
Su chau 5060
10000
5000
level
mao 4480
ali, 4050
erh 4540
hei 4830
ng po pien 4050
ng kuan 4870
han lu ping 4930
Ta lang 4300
r yn. shan 4510
chang 3210
ung Chang 2710
ng wa 4950
Yang mao 5420
Hsi hsien 5250
Hsun haing chan 5590
Hsin kai 5860
Chin-ning 6510
Chen kung 6440
Yun nan 6420
8000

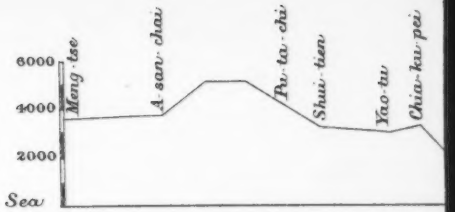


SECTION FROM SIANG YANG TO SINGAN.

Horizontal Scale, 1: 4,000,000 or 63·13 Stat. miles = 1 inch.

Scale of Miles.

0 50 100 200

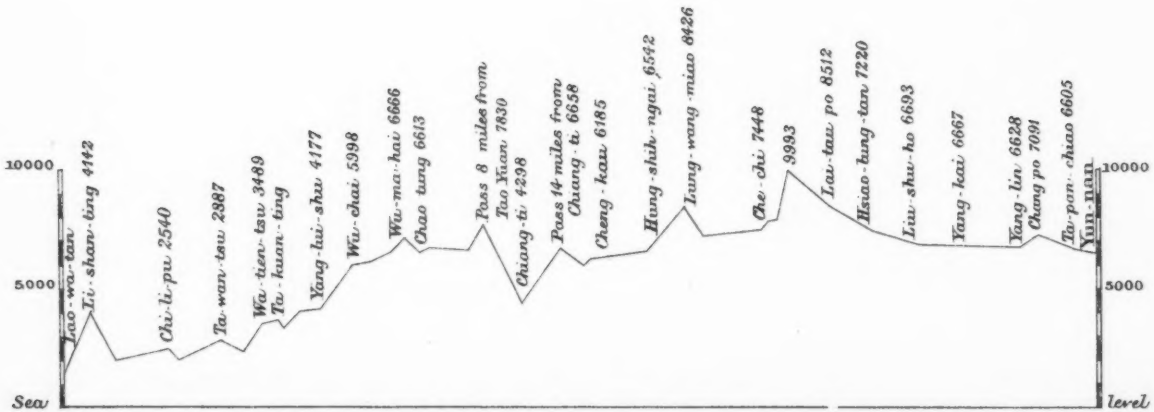


SECTION FROM MENG-TSE TO SONG-K

Horizontal Scale, 1: 1,000,000 or 15·78 Stat. mil

Scale of Miles.

0 5 10 20 30

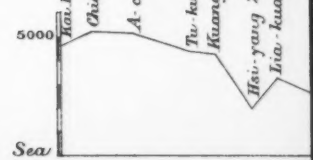


SECTION FROM LAO-WA-TAN TO YUN-NAN.

Horizontal Scale, 1: 4,000,000 or 63·13 Stat. miles = 1 inch.

Scale of Miles.

0 50 100 200

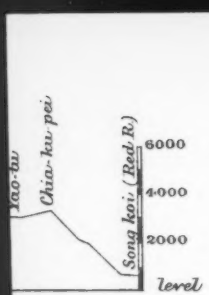


SECTION FROM KAI H

Horizontal Scale, 1: 4,000,000 or 63

Scale of Mi

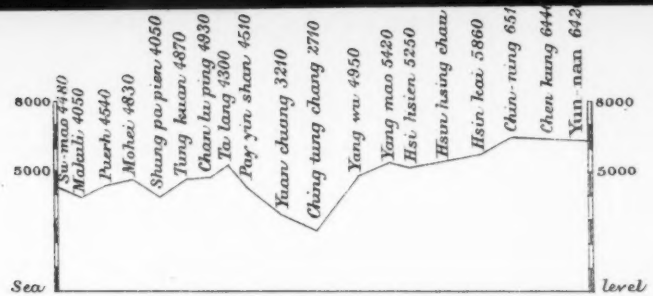
0 50 100



NG-KOI [RED R.]

at. miles = 1 inch.

40 50

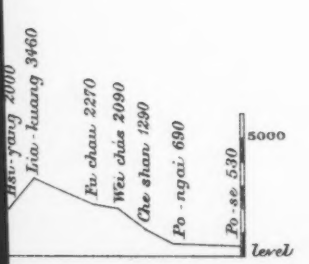


SECTION FROM SU-MAO TO YUN-NAN.

Horizontal Scale, 1: 4,000,000 or 63·13 Stat. miles = 1 inch.

Scale of Miles.

0 50 100 200

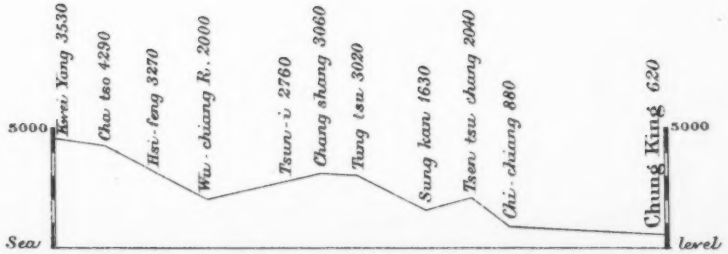


KAI HUA TO PO-SE.

or 63·13 Stat. miles = 1 inch.

of Miles.

100 200



SECTION FROM KWEI YANG TO CHUNG KING.

Horizontal Scale, 1: 4,000,000 or 63·13 Stat. miles = 1 inch.

Scale of Miles.

0 50 100 200

Horizontal Scale, 1: 4,000,000 or 63·13 Stat. miles = 1 inch.

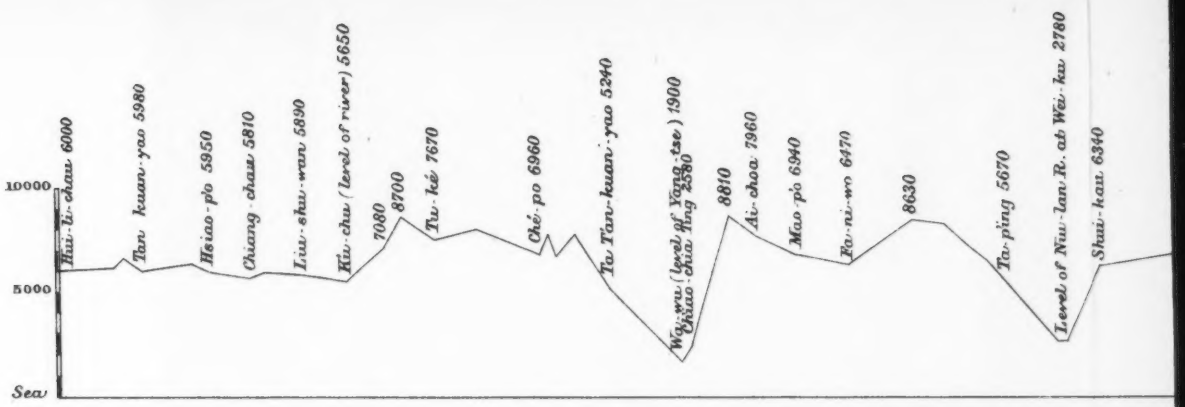
Scale of Miles.

0 50 100 200

Horizontal Scale, 1: 4,000,000 or 63·13

Scale of Miles

0 50 100

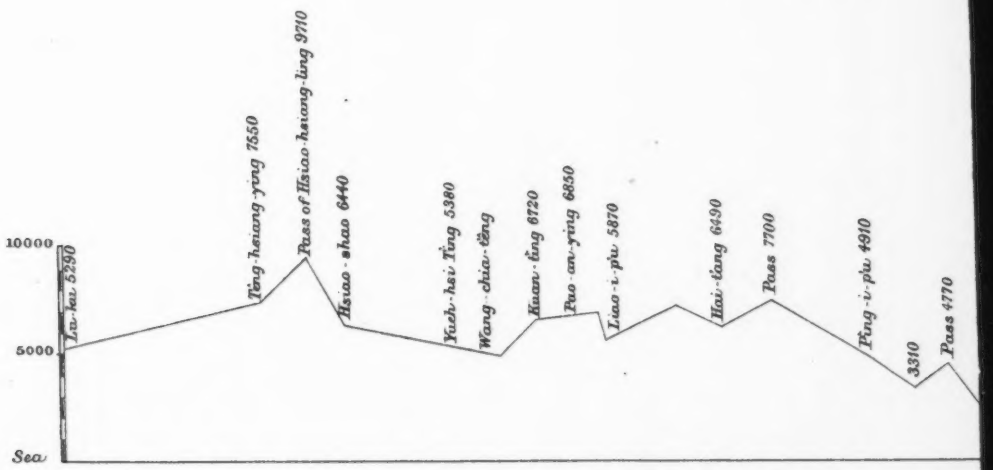


SECTION FROM HUI-LI-CHAU TO YANG-LIU-

Horizontal Scale, 18·4 Stat. miles = 1 inch.

Scale of Miles.

0 10 20 30 40 50



SECTION FROM LU-KU TO CHIN-KU-HO.

Horizontal Scale, 18·4 Stat. miles = 1 inch.

Scale of Miles

0 10 20 30 40 50

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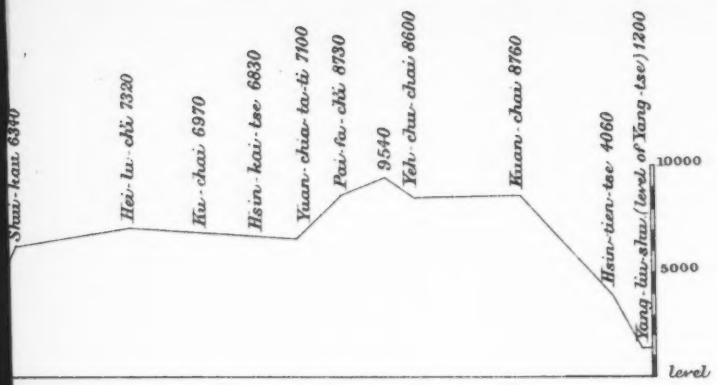
of Miles.
100 200

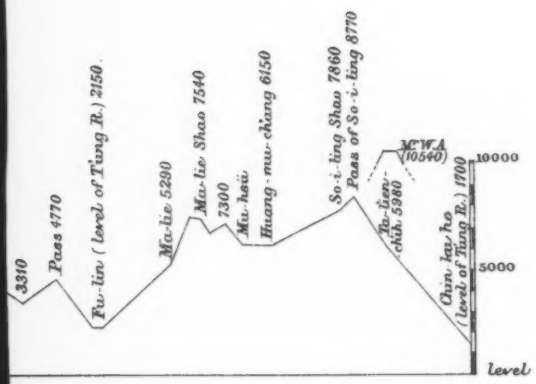
Horizontal Scale, 1 : 4,000,000 or 63·13 Statute miles = 1 inch.

Scale of Miles.
0 50 100 200



LIU - SHU.

50



-HO.

50

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